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The Fowl Pest Eradication Campaign

IN February this year the Ministry of Agriculture introduced further restrictions on the movement and marketing of poultry in an all out effort to reduce the incidence of fowl pest. Under the Live Poultry (Restrictions) Order 1954 which came into operation on February 5th the country was divided into " clean " and " dirty " areas, with rigid control on the movement of live poultry into the " clean " area to prevent the introduction of infection from outside.

Since the Order came into force 530 outbreaks of fowl pest have been confirmed, over 200 less than in the same period in 1953. Of the 530 outbreaks no less than 170 occurred in the spring in Lancashire, mainly in the central parts of the county. In the " clean " area only 11 outbreaks have been confirmed — the majority occurring within a month of the Order being made. In the rest of the country too, apart from Lancashire, there has been considerable improvement.

There has been a marked improvement in the reporting of suspicious symptoms of the disease by poultry keepers. Of the cases confirmed since February about 75 per cent. were reported to the Ministry; this compares with 25 per cent. in 1953.

The Ministry has now reviewed the whole position. It is felt to be undesirable to rely indefinitely on an artificial division of the country into " clean " and " dirty " areas as the sole, or even main, method of controlling and eventually eradicating fowl pest. The Ministry hopes that after a reasonable time—maybe within the next 18 months—it may be possible to dispense altogether with " clean " areas and deal with outbreaks on an emergency basis on the lines of the technique applied in foot-and-mouth disease, *i.e.* slaughter and a temporary " standstill " over a defined area until the situation is satisfactorily cleared up; such restrictions to be applied automatically, as quickly as possible, and without prior discussion or notice.

As an immediate step, it has been decided to extend the " clean " area to the following counties:—

Cornwall (including the Scilly Isles), Devon, Somerset, Gloucester, Dorset, Wiltshire, Cumberland, Northumberland, Westmorland, Durham, Yorkshire (North Riding), Yorkshire (East Riding) and the Furness division of Lancashire.

An Order to give effect to this decision will be made shortly to come into effect from about January 15th, 1955.

It is hoped that there will be a continued improvement in the fowl pest situation during the coming year. Particular vigilance is requested by the Ministry during December and January, the " peak " months for outbreaks during the past four years.

The progress reported against fowl pest will give additional topical interest to Dr. R. F. Gordon's Congress paper " Present Disease Position in the Poultry Industry," which we shall be publishing next week, together with the discussion which followed it.

THIRD CONGRESS PAPER

Myxomatosis

BY

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THIS paper, of particular interest by reason of its topicality, was discussed during the morning of September 22nd. The Chairman was Professor F. Blakemore, D.V.SC., B.V.SC., M.R.C.V.S., D.V.S.M., and the recording secretary Mr. I. H. Fincham.

THE CHAIRMAN, opening the discussion, said that only a few years ago myxomatosis was a name known to very few people, the disease was an academic curiosity, now it had become a household word. Considerable interest had been displayed in myxomatosis and its possibilities in reducing the rabbit population. At the same time there had been some public concern, and the remarks of Mr. Ritchie and his collaborators would be listened to with interest.

MR. RITCHIE, introducing the paper, said: The subject of this paper is certainly topical. Indeed myxomatosis has spread so widely throughout Great Britain since the paper was written that I must indicate the present distribution of it. It must of course be appreciated that one outbreak may cover much more country than another, and that in some of the affected counties the disease has become widespread while in others it is much more localised. It is still true that even in heavily affected areas there are pockets where the disease has not penetrated—a reflection, as we believe, of the comparative inactivity of free flying vectors this summer.

In the paper you will note that the table lists 76 outbreaks to the end of June. May I make a slight correction to that table by adding one outbreak each in Cornwall and Devon—these were reported later and the figure to the end of June is therefore 78. In July, 89 outbreaks have been recorded and they include the first two in Scotland, 19 in Wales (six counties with outbreaks for the first time), 78 in England (15 fresh counties). August had 88 outbreaks, 13 in Scotland (eight fresh counties), 11 in Wales (three fresh counties) and 65 in England (eight fresh counties). To September 13th there had been a further 38 outbreaks, 16 in Scotland (four fresh counties), two in Wales and 20 in England (three fresh counties). Between mid-October, 1953 and mid-September, 1954 there have been 293 outbreaks. The disease has appeared in every county in Wales, in all but seven in England (Westmorland, Isle of Ely, Soke of Peterborough, Hunts, Rutland, Derby and Middlesex), 14 counties are affected in Scotland—they exclude the South-west of Scotland, the Lothian and Border counties, Caithness and Inverness, but they include Orkney and Shetland.

We are getting more and more information that the broad jumps of infection are caused by human intervention and quite clearly it is in this way or by indirect means, as yet undisclosed, that infection has reached many areas; for instance, it cannot be mosquitoes that carried the disease to Shetland for there are no mosquitoes there.

There is, however, some circumstantial evidence that mosquitoes are playing a part in spread in some localities. In Sussex a domestic stock has become infected in a rabbitry with hutches well separated from each other. Some 50 rabbits have died. The owner has observed numerous mosquitoes in the hutches. In the Isle of Wight the disease is widespread except for a windswept area of downland where there are still numerous rabbits and no myxomatosis. (In the survey of warble fly infestation this year no warbled cattle were found in the same district). In the Isle of Wight, too, the disease has been found among domestic rabbits which most probably were infected from mosquitoes.

It is of interest that mosquitoes are invading hutches; for, as you will note in this paper, domestic rabbits have been exposed in hutches in areas where disease is present in the wild rabbit population. None of them have become infected and it had been suggested that mosquitoes would not invade the hutches in which these sentinel rabbits were posted. Nevertheless, it is intended that the present hutches be changed for others with six sides all wired.

Vaccine has been used quite extensively for domestic stocks and also to some extent for wild rabbits. In the rabbitry already mentioned 50 unvaccinated rabbits died but all vaccinates so far survive, although several have shown symptoms—some quite severe—and have survived beyond the normal time intervening between the onset of symptoms and death.

We have made and are making studies of this disease, the methods of its spread and case mortality rates, not only because of direct interest in the disease itself but because of the lessons we may learn from it. So far, for instance, it is quite evident that the movement of affected animals is a most important factor and is perhaps the only factor in spread of infection to distant points. Here we have a disease in an animal whose movements or transport cannot be controlled and the disease now stretches from Cornwall to Shetland. That is surely an excellent justification for the restrictions imposed on the movements of farm livestock when other virus diseases are being dealt with and when it is possible to arrest movement by the methods normally used—and with the co-operation of the farming community.

One more point. We have had suspicions reported that sheep have been affected with myxomatosis. In both instances a clear alternative diagnosis was made, in one case orf and in the other the condition followed the use of an anthelmintic. I have no direct knowledge of the enquiries which have been made into cases where owners have raised the question of this disease affecting dogs. We have no evidence whatever that any animal other than the rabbit is affected and do not expect to get any.

THE PAPER

The paper, which had been circulated in advance, was as follows :—

I. Introduction

Early History

THE disease was first recorded from Montevideo (Sanarelli, 1898) in laboratory rabbits—the domestic form of the wild European rabbit, *Oryctolagus cuniculus* (Linnaeus, 1758)—and subsequently occurred among domestic rabbits in the Argentine, Brazil and Southern California. The mortality rate is usually in the region of 99.5 per cent. Until 1942 it was not appreciated how this disease had originated among laboratory and domestic stocks, but in that year it was shown by Aragão that native wild rabbits of Brazil, *Sylvilagus brasiliensis* (Brisson, 1766), developed the disease in a mild form with no generalisation and a negligible mortality. This was apparently the source of infection of the domestic stocks.

Symptoms

This disease of rabbits, caused by a virus, spreads rapidly under favourable conditions and produces a very high mortality. The symptoms are usually characteristic and unmistakable. The first sign of infection is a clear watery discharge from the eyes. Within a day or two the discharge becomes thick and the eyelids swell. The rabbit is then blind with the eyes sunk into the swollen eyelids, which may be crusted with dry matter. Swellings appear notably at the base of the ears, on the nose, under the chin and around the anus and genital organs. Occasionally swellings are also seen on the body and feet.

The incubation period is from 5 to 7 days. The period from infection to death is from 11 to 18 days.

Transmission

Spread occurs by direct contact between rabbits and by the intervention of biting insects, especially mosquitoes and fleas.

It has been shown that the cat flea, *Ctenocephalides felis* (Bouché, 1835), the Australian stickfast flea, *Echidnophaga myrmecobii* (Rothschild, 1909), the rabbit flea, *Spilopsyllus cuniculi* (Dale, 1878), the rabbit louse, *Haemodipsus ventricosus* (Denny, 1842), a mite, *Cheletiella parasitovorax* (Mégnin, 1878), and several species of mosquitoes can convey infection. Transmission is mechanical (Fenner, Day & Woodroofe, 1952).

Specificity

All efforts at artificial transmission of the disease to other animals, which have included monkeys, domesticated species, rats, mice, guinea-pigs, marsupials, hares and birds, have failed. In the course of the epizootic in France however *three* hares were found affected (Jacotot, Vallée & Virat, 1953; Magallon, Bazin & Bazin, 1953). Man is not susceptible.

Biological Control

Since the wild rabbit is looked upon almost universally as a pest, it is not surprising that efforts have been made to utilise a disease having such a high mortality for biological control. Rabbits are a major problem in Australia and experiments were conducted to assess the possibility of the successful introduction and spread of the disease in that country. Laboratory tests and experiments in outdoor cages at Cambridge (Martin, 1936) showed that close contact between rabbits was necessary for the spread of infection and that while blowflies could pick up virus, the healthy rabbit did not sufficiently tolerate their presence on his eyes and nose for transmission to occur. When infected rabbits were introduced into outdoor cages all their healthy cage-mates were affected by the disease. Spread was apparently by direct contact, but the rôle of fleas in transmission was not appreciated at the time and they may have played a part. Further experiments were carried out in Australia, and in the presence of the native stickfast flea, which had been shown by laboratory studies to be capable of conveying infection, some success was achieved. Attempts to introduce infection on a field scale, mainly in semi-arid areas, were however not very successful (Bull & Mules, 1944). About the same time, experiments in Europe, including the island of Skokholm off the Pembrokeshire coast, met with only limited success (Jensen, 1939; Hvass & Jensen, 1939; Lockley, 1940). More recently, introductions of myxomatosis into Tasmania and New Zealand have failed to produce epizootics (Meldrum, 1954; Filmer, 1953). In 1952 infected domestic rabbits were introduced into two uninhabited islands in the Outer Hebrides but, while there has been a reduction in the number of rabbits, the disease is not now established.

It is already well known that the later Australian attempts to introduce the disease as a control method were much more successful (Ratcliffe *et al*, 1952). An introduction of infection into France in June, 1952, intended to eradicate rabbits on a particular estate, led to a widespread epizootic in 1952-53 except in Western Brittany and the mountainous regions (Delille, 1953, Jacotot & Vallée, 1953). From France the disease has spread to many European countries, including Belgium, Luxembourg, Germany (Hase, 1954), the Netherlands (Lankamp, 1953), and Spain and it is also the probable source of the British infection (Thompson, 1954).

II. The Disease in Great Britain

History

The first outbreak of disease in this country was confirmed on October 13th, 1953, at Bough Beech, near Edenbridge, Kent. From the evidence that has been obtained in the locality it would appear that the infection must have reached the district in August or early in September but it has not

been possible to discover how the infection was introduced. A second outbreak was confirmed on October 17th near Robertsbridge in East Sussex. At this stage it was considered advisable, until a definite policy could be adopted, and to allow for an objective study of the whole problem, to endeavour to restrict the spread of infection. Rabbit fencing was erected around the areas which were judged to contain the infected rabbits and efforts were made to kill all the rabbits within the enclosures. However, further outbreaks occurred on land which it would have been impracticable to fence off and, while every attempt was made to destroy the rabbits, it soon became clear that these efforts were unlikely to stamp out the disease.

An Advisory Committee was set up by the Minister of Agriculture and Fisheries and the Secretary of State for Scotland "to advise on the problems arising in connection with myxomatosis in rabbits and the action that should be taken by the Government". This Committee, after full consideration of the evidence, including the effects of the rabbit pest on agriculture and forestry, the considerable trade in fur felt and rabbit meat, the sizable population numbers built up again. It was considered essential that special steps should be taken to protect the domestic rabbit population against the disease. A Scientific Sub-Committee with a small Research Group was set up, and it is the work of this Research Group which is particularly discussed in this paper.

At first the disease travelled slowly over fairly well defined areas in south eastern England but more recently has appeared at widely separated points and by the end of June had found in counties as far north as Norfolk and Anglesey and as far west as Cornwall.

Transmission in the Field

While some local spread may have occurred by contact between individual rabbits, the laboratory work does not suggest that this can have been a major factor. During the winter mosquitoes could scarcely be implicated, since the sylvan species most likely to bite rabbits overwinter only as eggs or larvae, and attention was therefore concentrated on possible ectoparasitic vectors. Since the relatively sessile Australian stickfast flea had been shown to

OUTBREAKS OF MYXOMATOSIS (OCTOBER 1953—JUNE, 1954)
(Every fresh outbreak is at least five miles from an existing outbreak)

1953	Kent	E. Sussex	Essex	E. Suffolk	Isle of Wight	Radnor	Gloucester	Cornwall	Bedford	W. Suffolk	W. Sussex	Norfolk	Pembroke	Anglesey	Devon	Cardigan	Oxford	Bucks	Berks
Oct.	1	1																	
Nov.	1	1	1																
Dec.	1		1	1															
1954 Jan.	1		1																
Feb.	1																		
Mar.	2	1	1		1														
April	2	1		2															
May	4	1	1	1		1	1	1	1	1	1	1							
June	1	1	2	2	1		6	6		1	1	4	4	4	4	1	1	1	1
	14	6	7	6	2	1	7	7	1	2	2	5	4	4	4	1	1	1	1

of domestic rabbits and the humanitarian aspects of the problem, recommended that while attempts to restrict the spread of disease would serve no practical purpose, no attempt should be made to assist its spread or to introduce myxomatosis into unaffected areas of the country (M.A.F., 1954). In other words, the disease should be allowed to run its course among wild rabbits. It was further thought that the undisturbed spread of infection, by eliminating all the rabbits in the affected areas might cause the disease to die out and so prevent it overwintering and then spreading more rapidly in the spring when flying vectors could begin to play their part. The Committee also recommended that every advantage should be taken of the unique opportunity to eliminate the survivors of outbreaks before their

be a vector, it seemed probable that the common European rabbit flea would also transmit myxomatosis. This flea is not present in Australia or New Zealand. Laboratory work by Shanks and Allen, at Aberdeen, showed as long ago as 1952 that the European rabbit flea could be an effective vector of myxomatosis and this has been confirmed by field and laboratory work (Lockley, 1954; Muirhead-Thomson, 1954). Since they can survive on the bodies of dead rabbits for several days and still remain infective, fleas alone could account for the local spread of myxomatosis but not for the uneven dispersal that has so far been characteristic of the disease in this country. Besides being found at fox earths, the bodies of diseased rabbits are reported to have been attacked by carrion crows, mag-

pies, gulls and buzzards. Predators and scavengers may thus have assisted in spreading the disease, possibly by transporting infective rabbit fleas from place to place. There is ample evidence, however, that farmers and others have taken sick rabbits from known myxomatosis areas to other parts of the country and myxomatous rabbits have fetched high prices on the grey market.

From Australian experience it was expected that in late spring or early summer, mosquitoes and other flying vectors would play a large part in spreading myxomatosis and that the disease would become epizootic. Cold weather delayed emergence of adults by about a month this year, but the woods are now full of mosquitoes, which are evidently not biting rabbits. From March of this year six tame rabbits have been exposed to natural infection in woods near the first outbreak of myxomatosis in Kent. Each rabbit is kept in a hutch attached to a tree at about five feet from the ground and one side of the hutch is covered only by 1-inch mesh wire netting. As the surrounding wild rabbits die from myxomatosis, the hutches are moved to fresh areas where the disease is active; at the time of writing, all six domestic rabbits are in good health. Studies of mosquito-rabbit ecology carried out by Dr. Muirhead-Thomson in this part of Kent confirm that, up to the end of June, mosquitoes although abundant have not been feeding on wild rabbits. By increasing the mosquitoes' rate of metabolism and consequently their incentive to feed, warmer weather could completely alter this picture (Shute, 1954).

Rate of Spread of the Original Outbreak

In October, 1953, some 200 acres were enclosed by rabbit-proof wire netting in an attempt to contain the initial outbreak near Edenbridge, Kent, and over 400 rabbits were killed in the fenced area. Although further outbreaks were reported from East Sussex, Essex, East Suffolk and other parts of Kent before the end of the year, the attempt to restrict the spread of myxomatosis at its primary focus appeared to delay its spread there for a time. The course of the disease in the Edenbridge area has been closely followed by Major C. J. Armour, who reports the following results. In November, myxomatosis appeared at one farm close to the fenced area but not at any other until January, 1954. There were 16 further farms carrying infection by the end of February, 30 more in March and 17 in April, when myxomatosis was present in an area of about 35 square miles and at 65 locations. By the end of May, there were five additional infected localities and 51 more in June. This outbreak had now spread from its original 200 acres to an area of 96 square miles and, in May, had joined up with a nearby independent outbreak near Sevenoaks, Kent (confirmed November 20th, 1953).

Although myxomatosis is present throughout this area, by no means all the warrens have been depopulated. As was the case in France, the spread of the disease is irregular. It has appeared on one part of an estate and moved gradually through some woods and fields, while others have been left untouched and supported healthy rabbit populations for weeks or even months. This erratic spread is, of course, compatible with the belief that the principal vectors so far have been ectoparasites and not flying vectors.

Myxomatous rabbits normally die above ground and it is suggested that by wandering beyond their normal range during the later stages of the disease, they could themselves spread it appreciably. To obtain information on this point, healthy rabbits living close by infected areas have been caught, marked and released at the point of capture; 35 have been marked in the Edenbridge area and 28 in Essex but none of them has yet been recaptured or found dead.

Experiments on Transmission

In view of the discrepancies that existed between the results of Martin's experiments at Cambridge made with a laboratory strain and reports emanating from France on the ways in which myxomatosis was spread in that country, it was thought advisable to repeat and extend Martin's work using a strain recently isolated from a field outbreak. Mr. Paterson at Wye has been responsible for studying the spread of the disease in the absence of insect vectors and his observations have afforded clear confirmation of Martin's findings. The disease will usually pass from an infected to a healthy rabbit if the two are housed together in one cage. On the other hand, it has invariably failed to pass from one rabbit to another maintained in another cage 6 inches away. It must be added that three or four accidental infections have occurred in the experimental rabbit house at Wye, in spite of strict measures to control fleas and the cause of these accidents is not known. The rarity of these accidental infections, however, obviously confirms the inability of the virus to spread regularly by droplet infection. We maintain healthy rabbits in cages amongst our infected rabbits at Weybridge where, over several months, we have had no accidental infections.

If one removes a rabbit recently dead of myxomatosis from a cage and, without cleaning the cage, introduces a healthy rabbit, the latter may, but will not always, become infected. Infection has on one occasion persisted in a cage for 12 hours, but Mr. Paterson has not been able to infect rabbits introduced 24 hours after the diseased rabbit has died and been removed. A more interesting and natural variant of this experiment has been to enclose a 3 ft. square of grass and place infected rabbits there from 9 a.m. to 2 p.m. On their removal, healthy rabbits have been placed in the pen and left until 5.30 p.m. This has been repeated daily from the time that infected rabbits have shown symptoms until they have died, using the same healthy rabbits each afternoon. In one experiment exposures continued for six days and in two experiments for five days. In no case has a healthy rabbit become infected.

Instillation of virus into the conjunctival sac is a very successful method of infecting normal rabbits but is less likely to provoke the disease in vaccinated rabbits than is inoculation through the skin.

In order to check the French stories of virus being transported on motor car tyres, a piece of sheet

rubber was smeared with virus from subcutaneous lesions and, taking care to avoid the eyes, wiped across the nose and mouth of two rabbits. These rabbits did not become infected.

Grass heavily sprayed with virus was placed in a cage with two rabbits at 4 p.m. They were not seen to eat the grass before 5.30 p.m., but it had been completely consumed by the following morning. One only of the two rabbits, in due course, developed myxomatosis. Two rabbits consumed a leaf of cabbage smeared with virus; they did not become infected. Experiments on infection by ingestion are continuing.

It would appear from these experiments that, *in the absence of insect vectors,* myxomatosis will only spread readily from sick to healthy rabbits when they are maintained in close contact. Although the ingestion of grass heavily sprayed with virus provoked infection in one rabbit, it is clear that there can be little danger of infection being passed to healthy rabbits by feeding grass to which infected rabbits may have had access. Possibly the experiments also suggest that, as a rule, the quantity of virus eliminated by a sick rabbit is relatively small.

The transmission of myxomatosis by pricking the skin with a contaminated dissecting or sewing needle has been abundantly confirmed both at Wye and at Weybridge. Mr. Paterson infected a number of such needles and placed them in test-tubes in a dark cupboard on May 7th. A rabbit pricked with one of these needles on May 18th showed symptoms on the 26th and died on the 31st. After 20 days storage a needle failed to infect a rabbit.

This is a very certain method of infection when using freshly contaminated needles and it has been adopted as the final test for immunity of vaccinated rabbits.

Experiments on Vaccination

As in the case of the pox group of virus diseases, to which the virus of myxomatosis is akin (Fenner, 1953), no practical success has been achieved by various workers who have tried to prepare an inactivated vaccine against myxomatosis. The only way of immunising against the disease normally would be by developing an attenuated strain of the virus. This has been attempted: Weston Hurst (1937) described the results of passaging the virus intracerebrally in rabbits and found that of 21 rabbits inoculated intradermally with material of the 8th to 23rd passages 16 recovered. Passage of this strain is being maintained at Weybridge, but the results of testing the virulence of the 10th local passage of the virus by subcutaneous inoculation are not available at the time of writing. It may be mentioned that the virus still produces viscerotropic rather than neurotropic symptoms after intracerebral inoculation and is not, therefore, fully adapted to propagation in the brain.

Fortunately, it has been known since Shope first described his fibroma virus of rabbits that this virus interfered with that of myxomatosis and that a rabbit which had been inoculated with the fibroma virus could be protected against myxomatosis (Shope, 1932). Shope's fibroma virus is closely related to myxoma virus and, like it, originates from a species of *Sylvilagus,* in this case the North American "cottontail". Experiments at Weybridge on rabbits have shown that of 54 vaccinated rabbits, 33 gave no reaction on challenge, fifteen reacted and recovered and six died; in other words 48 out of 54 or 88.9 per cent. had a serviceable immunity. These figures may be broken down as follows:—

Period before Challenge	Under 2 months	2 to 4 months	Over 4 months
Serviceable immunity	15	20	13
Not protected	1	4	1

Subcutaneous inoculation with fibroma virus usually leads to the formation of a "fibroma". In many instances these are very small, but occasionally they reach the size of a walnut or even larger. They begin to appear in 6 to 12 days, attain their maximum size in 11 to 21 days and disappear in a month or two. In practice when the usual vaccinating dose of 1000 m.i.d. was used 69 out of 85 rabbits or 81.2 per cent. developed palpable tumours. The appearance of this reaction is no indication of the development of immunity against myxomatosis. Of the 54 rabbits which were challenged four had not produced fibromata and, of these, three were completely immune and one had a serviceable immunity. On the other hand, two of the rabbits that succumbed after challenge had developed lesions 4 cm. across and others had shown swellings measuring 2 or 3 cm.

Inoculation of fibroma virus is usually free from risk of producing any untoward effect. Rabbits under one month of age born of a susceptible doe may, however, develop very large tumours and die. If the doe has been immunised, the offspring can be injected with safety at an earlier age, but this may affect duration of the immunity conferred, an aspect which Mrs. Rowe is now examining at Weybridge. Provided that pregnant rabbits are not otherwise disturbed abortion is not provoked. Jacotot, Vallée and Virat have recently (1954) considered the question of generalisation of fibroma virus. Out of tens of thousands of rabbits vaccinated in France only three cases of generalisation have been noticed. One was a case reported by Jacotot, Levaditi, Vallée and Virat (1954) of a vaccine producer which developed 24 fibromata and subsequently died; two were among six Angoras vaccinated by a practitioner. These developed site tumours the size of a hen's egg and a number of secondaries. All the tumours regressed normally.

As it is essential that the virus in the vaccine be alive when inoculated, it is necessary to take care not to use it after the expiry date or to expose it to high temperatures or strong sunlight. Traces of disinfectant left in a syringe may render the virus inert and the vaccine ineffective. It has been shown by Mrs. Rowe that by freeze-drying, a vaccine with a life of at least five months can be prepared. Such a vaccine would be considerably more expensive to produce commercially and for the protection of rabbits it is clear that cost should be kept to a minimum. Up to the end of June the Wellcome Research Labo-

ratories had issued vaccine sufficient for some 20,000 rabbits.

Ecological Aspects

It is impossible to assess the full effects of myxomatosis in Great Britain; we can only indicate the way things are going.

The disease has spread over the whole of France, with the exception of Brittany and some parts of the Alps and Pyrenees. It is therefore possible that it will spread over most of Great Britain. There has been considerable lateral spread from the original outbreaks, and since mosquitoes have not been active, the disease might have been expected to extend very gradually. However, it has been conveyed to fresh areas by human agency and this has resulted in multiplication of local outbreaks, from all of which natural but gradual spread may occur. A spell of warm weather with mosquito activity could change the picture completely and result in myxomatosis becoming really widespread throughout Britain.

Field evidence from France and this country indicates that the virus strains in Europe are of very high virulence. Virus isolated from the original outbreak in Kent has been examined by Professor Fenner who considers it more virulent than strains recovered from the field in Australia. Experiments at Wye and Weybridge suggest that there is no variation in virulence in the strains subsequently examined.

There have been very few survivors in France, and we are finding none here. Although shortly after the first outbreak was diagnosed we recovered a rabbit which proved to be immune, the only "survivors" which we have encountered since have proved to be susceptible rabbits: some, in fact, have been incubating the disease. These are apparently from pockets into which myxomatosis has been slow in penetrating and are not true survivors. This is consistent with the inactivity of mosquitoes. The situation is being watched and the sera of rabbits found in areas where the disease has existed for a few weeks are being examined by neutralisation and complement fixation tests.

The studies of spread of myxomatosis in Kent will continue. However, properly to assess case mortality-rates and the immune status of infected populations, it will be necessary to observe several areas with high rabbit density and sparse human populations before and after the advent of disease. Ever since the arrival of myxomatosis in England the Nature Conservancy have been concerned about the effect that a very considerable reduction in rabbit population would have upon our flora and fauna and since, in several areas designated as Nature Reserves, there are examples of rabbit conditioned vegetation these would appear to be ideal sites for myxomatosis studies.

Information on rabbit predators is inadequate, but foxes and stoats and to a lesser extent badgers, buzzards, eagles and some hawks feed on rabbits. A reduction in rabbit numbers would compel them partly to change their feeding habits and this might mean, for example, that foxes for a time would take increased toll of fowls and lambs in some parts of the country.

In France hares are apparently increasing in areas where myxomatosis has affected the rabbits. This point will be carefully studied here.

Summary

The paper briefly outlines the history of this virus disease of rabbits. Its first appearance was in laboratory stock, the domestic form of the wild European rabbit, in Uruguay. The disease later appeared among domestic stocks in Brazil, Argentina and Southern California. It was later established that the virus was harboured by the native wild rabbit *Sylvilagus brasiliensis*.

The symptoms are described and methods of transmission discussed, including reference to insect vectors.

Only rabbits are susceptible but during the epizootic in France it is recorded that three hares were affected.

Attempts to use the disease as a method of rabbit control are summarised.

More particular reference is made to the outbreaks which have occurred in Great Britain since October, 1953. The extent of the disease up to the end of June, 1954, is given and observations on the means by which the disease has been spread are reported. Reference is made to a particular study of the original outbreak and the possibility of flea-borne infection and infection from flying vectors.

Experiments on transmission confirm that in the absence of insect vectors myxomatosis will only spread readily from sick to healthy rabbits when they are maintained in close contact. The disease can be conveyed mechanically by puncture of the skin with a dissecting needle contaminated by virus material from a lesion.

Vaccination with Shope's fibroma virus has given a serviceable immunity in 88.9 per cent. of cases. Protection is not related to the production of a fibroma in the vaccinate. Generally the inoculation of fibroma virus is free from risk. Rabbits under one month of age, born from a susceptible doe, may develop large tumours and die; young from an immunised doe may be vaccinated with safety, although possibly the duration of their immunity may be reduced. Abortion is not induced by vaccination of pregnant does provided they are not otherwise disturbed.

The ecological aspects of the problem are mentioned and the prospects of spread over Great Britain and the possible effects of a reduction of rabbit population on rabbit predators are discussed.

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To avoid overloading the text, many references have been omitted from the Introduction; these may be found in an earlier paper (Thompson, 1954).

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THE OPENER'S SPEECH

Professor R. E. Glover expressed his appreciation of the opportunity which had been afforded him by the Provisional Committee of opening the discussion on this paper. When he was asked to undertake this task, he had some hesitation in accepting because he felt that the authors of the paper would provide a comprehensive and balanced account of this highly infective disease. Such had proved to be the case, and he offered his congratulations to them on the excellence of their contribution.

He felt he could add nothing of significance to the analysis of the situation in this country at the moment. It might, however, be useful to consider what might happen in the future, and the repercussions of a continuation of the spread of myxomatosis. The authors suggested that the disease, having been introduced and having established itself, would, in all probability, become a permanent killing disease of the rabbit in this country. It would, however, be unwise to conclude that the wide dissemination of the virus over parts of western Europe would necessarily provide the pattern of what might occur in the United Kingdom. It was obviously highly speculative to attempt to forecast what might occur next winter, but there were at least three possibilities which might be considered.

(1) Prior to the current outbreaks, attempts to establish myxomatosis on islands off our coast resulted in a temporary stabilisation of the disease but its eventual disappearance. Although the rabbits were seriously reduced in numbers, the build-up to the pre-epidemic figure was rapid. Many factors, such as the type of insect vector, climatic conditions and so on, may have played a major part. Similar conditions prejudicial to the perpetual existence of the virus might lead to the extinction of the present outbreaks. It was significant that, in some parts of Australia, where rainfall and other circumstances were unfavourable for the development of suitable winged vectors, it had been necessary to re-introduce the virus on more than one occasion; indeed, it would be fair to say that such deliberate releases of freshly infected rabbits were very common in that country. It would, therefore, be rash to assume that the disease would necessarily persist indefinitely in the absence of fresh seedings of virus deliberately introduced by man, a factor which had undoubtedly played a major part in the current outbreaks, and the disease might disappear. It was of interest that in Tasmania and New Zealand, efforts to establish myxomatosis seemed to have failed.

(2) The current epidemic if coupled with energetic measures for the extermination of those animals which escape or survive infection, as recommended by the Ministry of Agriculture, should result in the denudation of many districts. They might then become vulnerable to invasion by rabbits from surrounding areas which had been less severely hit. Would myxomatosis persist under these conditions? Experience in Australia had shown that where, through the intervention of the disease, the rabbits were sparse, myxomatosis had the greatest difficulty in maintaining itself without fresh introductions of virus: it tended to smoulder and was only likely to develop into a major epidemic if suitable insect vectors were present. There was the additional complication of survivors immune to the disease.

(3) The third possibility was that the virus became established, as appeared to be the case at the moment, and, as has so often been stated recently, we may finish up with "both rabbits and myxomatosis." In this event, there was no guarantee that the virus would continue to behave as it had in the current outbreaks, *i.e.* to produce a fulminating epidemic with a fairly high rate of spread, a short incubation period and a high mortality.

Mutations of the Virus

There was abundant evidence in the general field of virus epidemiology that many viruses were unstable. A most important feature, therefore, of the impact of myxomatosis on the rabbit population over a long period, was the possibility of mutants arising. Most viruses were capable of some measure of adaptability, but there were wide variations in stability. In some, there was a marked capacity for the development of new strains which were immunologically different, possibly to a minor degree, from their parents, *e.g.* the "A" strains of foot-and-mouth virus or the changes in antigenic composition of the human influenza viruses whereby strains isolated from successive outbreaks showed some minor deviation from preceding strains. On the other hand, there were many human and animal viruses in which there seemed to be a strong stability of antigenic constitution, *e.g.* measles, rinderpest and so on. Mutations which arise in this group were mainly related to evolutionary changes in symptomology. In the light of present knowledge, it would seem that myxomatosis belonged to the second group; at any rate, no evidence had yet been furnished of the emergence of strains which were immunologically distinct.

It was quite evident from the Australian experience of the disease that a mutation of myxoma virus had already occurred. Fenner, who had made a very careful study of a number of strains, was convinced that the virus responsible for the outbreak in France—and presumably for the disease in this country—developed more quickly, was more acute in its symptomology and was more highly infective than the Australian strains, and was therefore more suitable for initiating an epidemic. He was equally sure that in the course of an epidemic, strains were bound to arise which would be less infective. Some viruses which had been recovered from the field in Australia were clearly attenuated. The incubation period was longer, the duration of the lesions more protracted and a high proportion of the animals recovered. Such rabbits often showed a deplorable condition of advanced emaciation, eyes sunken, closed and discharging pus, and numerous swellings about the body.

It should be noted, however, that any changes observed in the characters of the virus were related to its infectivity for the rabbit. It could not be too strongly emphasised that, with the doubtful exception of the hare, there was no evidence whatever that under natural or experimental conditions, myxoma virus could infect man or domestic stock. Recently, communications had been made to the Press that dogs, cats, sheep, etc. had become infected with the virus: such statements were without foundation and were ill-advised since they might give rise to needless anxiety in the minds of the public.

After the initial widespread incidence of myxomatosis in Australia, which in certain districts reached its peak in the first three months of 1953, the incidence of the disease in some areas had been patchy and the build-up

restricted. How far this was due to unfavourable climatic conditions, how much to the reduction of the rabbit population, how much to the emergence of mutant viruses, and how much to the influence of resistant survivors, was difficult to determine. The factor of immunity was obviously of great importance, since in some areas recently sampled, 100 per cent. of the survivors possessed immune bodies as against 45 per cent. after the first outbreaks. Clunies Ross had expressed the view that the problem created by the increasing proportion of rabbits which recovered from the disease, whilst as yet not serious, might become an important factor in the future. Burnet and Fenner considered that a reduction from the 95 per cent. kill in the original outbreaks to 90 per cent. or less this year was a most serious factor.

It would appear, therefore, that if the greatest benefit to agriculture was to be secured from the present outbreaks, the most vigorous campaign must be waged. The view had been expressed that since myxomatosis had reached this country, the least cruel method was to encourage its spread as quickly and as widely as possible in order that rabbits which were infected would suffer from the severe form of the disease with rapid death. This was a most understandable argument and would be justifiable if one could guarantee that other measures to root out the survivors were being pursued with unrelenting vigour. In the absence of such a campaign, myxomatosis would only provide a temporary relief, and any permanent reduction of rabbits would be possible only if fresh releases of virus were deliberately made—a policy which the Government Committee could not, at present, support.

Members of the veterinary profession would benefit from the excellent description of the disease given by the authors of the paper. They might at any time be asked to confirm its existence in domestic rabbits which were seriously menaced by the current outbreak, and they might be called upon to vaccinate susceptible stock. It would be of value to learn from the authors whether they regarded the present fibroma vaccine as sufficiently active to give a durable immunity in a high proportion of inoculated rabbits. This point was made because Shope's fibroma virus, on passage through the domestic rabbit, may undergo a mutation. Such mutants were not so effective in affording protection against myxomatosis, and it was therefore desirable to use material for vaccine production which was derived from an early passage from the original fibroma in the cotton-tail rabbit.

THE GENERAL DISCUSSION

Dr. R. F. Montgomerie (Wellcome Research Laboratory) said that this review of the subject should give the Press the opportunity of correcting the misconceptions which have been spread about the land. The three gentlemen who had prepared the paper were attached to the Ministry of Agriculture, to the Animal Health Division and to the Veterinary Laboratory at Weybridge, and with the customary modesty of such gentlemen, they had completely missed making one point. It was, in his view, very greatly to the credit of the Ministry, and particularly of course to the Laboratory at Weybridge, and to Mr. Hudson himself, that there was sufficient foresight used so that vaccine for the protection of domestic rabbits against this disease was issued as soon as the Carrington Report was available. The profession was criticised at times for being a little slow, but on this occasion no criticism could be laid at the door of those who were responsible in this matter. If his memory served him aright the Carrington Committee's Report was placed before Parliament on a Friday and the vaccine was available on the following Monday.

There had been some criticism of the Press that morning and he would suggest that that body should go to the fountain head for its information. The misconceptions which had been published had caused a great deal of anxiety to many animal owners in this country. However, there was a credit due to those who informed the public. The paper quoted the fact that up to the end of June 20,000 doses of myxomatosis vaccine had been issued for the protection of the domestic rabbit population. Thereafter, following on the publicity by the B.B.C. and the Press, the figure had risen very sharply to 67,000 doses in early September. The publicity informed the rabbit-owning population of this country that they could get a good level of security if they would turn to the veterinary profession for assistance.

There was one question he wished to ask: there was evidence of a level of resistance among some wild rabbits but it was not clear whether resistant rabbits bred resistant progeny.

Dr. W. R. Wooldridge joined in thanking the previous speakers for bringing forward their knowledge of this disease. He would also thank Professor Glover for his remarks about mutation. Many members would understand why he did that, because in very many organs of the local Press he had been misquoted as saying that in all probability this disease would affect other species of animals. He did on an occasion say something similar to what Professor Glover had put forward about mutations with species of viruses, but he would like to say, here and now, that he did not say anything about spreading to other animals.

Recently, on visits into Gloucestershire, where there had been a heavy mortality amongst rabbits, he frequently stopped and examined the carcases: among these carcases were two hares. Unfortunately they were not examined in the laboratory, one only observed them, but, nevertheless, he thought they were suffering from myxomatosis. No doubt that would be confirmed later if it did occur.

He would like to congratulate, with Dr. Montgomerie, all those who had done so much, including two groups not mentioned by Dr. Montgomerie. As might be suspected, one was the Wellcome Foundation which got that vaccine going and ready for the public in record time once they were allowed to do so. He would also like to express the profession's appreciation to Mr. Thompson and the Pest Division of the Ministry of Agriculture for their part in this work.

Owing to the frequent reference to the Trust in connection with myxomatosis an offer was made to investigate any case of alleged myxomatosis in any other species of animals than rabbits and hares, and the Trust was privileged to investigate a much publicised dog which was alleged to be suffering from myxomatosis within the Royal Counties. By agreement with the local veterinary surgeon, the animal was examined clinically, and specimens taken for laboratory examination. The examination showed that the animal which was alleged to have suffered from myxomatosis was not at the time the Trust examined him, suffering from any virus disease, but he was suffering from sarcoptic mange of the head and fore limbs.

THE REPLY

Mr. H. V. Thompson, in reply to the discussion, said it was not known how the disease would travel this year. It had survived one winter. After the efforts made to contain the disease in October and November, 1953, he was doubtful whether it would survive the winter at all, but there were a few outbreaks during the winter and early spring. Since the disease had survived the past winter and had spread over almost the whole of the British Isles there was little doubt that it would survive the next winter. What would happen next spring was a matter for speculation. This year had been most unfavourable for flying vectors.

On the basis of the Australian experience it was expected that mosquitoes would play a considerable part in the spread of the disease and that they had played a large part last year in France; but no real confirmation of that had been obtained from French workers. The French had had a large number of outbreaks amongst their domestic rabbits and there had been some similar outbreaks in Holland, Belgium and Germany; it seemed that these outbreaks of myxomatosis must in the main be transmitted by mosquitoes. The French did not believe that fleas, which were undoubtedly the main insect vectors in Britain, had played any great part on the Continent. Flying insects were active as vectors on the Continent, and under better weather conditions next year might be so in this country.

The fact had to be accepted that deliberate spread of the disease by man had been considerable during the past year. As well as mosquitoes, the *Culicoides* midges might have played some part in spreading the disease but they had not yet been incriminated.

Professor Glover had referred to the fact that the disease was dying out in Tasmania and New Zealand; he was glad to hear that because not much news about these two countries had been available here. According to information he had received—he had no personal knowledge of Tasmania or New Zealand—they did not have the European type of rabbit flea there and it was possible that the absence of this flea was the main reason why the disease had not survived. Provided that myxomatosis was widely distributed throughout the country he thought the rabbit flea would cause the disease to spread locally for a number of years.

There might be resistant strains developing in this country but so far there was no evidence of it. As Professor Glover had said the mortality had been extremely high. A small number of areas had been under monthly observation and in two of these the disease had arrived subsequent to beginning observations and the mortality, of which it was hoped to get accurate figures, was certainly over 99 per cent. If this high level of mortality was maintained he saw no reason why myxomatosis should not continue for several years to kill rabbits in different parts of the country, although whether it spread rapidly each year depended upon whether insect vectors were at work, and what the public did. The Ministry had taken the view that it could not approve of deliberate spreading of the disease, and there were many humanitarian interests in this country which were against it; the situation here was therefore different from that in Australia. The Ministry was watching the spread of the disease but was taking no active part in it, and as a result developments here as compared with Australia were bound to be different, quite apart from climatic and vector differences.

Mr. J. R. Hudson thanked Professor Glover and the members of the audience for the kind remarks made on the work at Weybridge. There were one or two points which perhaps he could answer and he would like to add a few notes which would bring the paper up to date.

Mr. Thompson had dealt with the question of the possible persistence of myxomatosis in this country. He thought that the existence of the rabbit flea in this country made the position different from that in the southern hemisphere. It seemed to him that there was a strong possibility of the disease persisting unless steps were taken to eradicate the rabbits.

As to the development of different strains of myxoma virus, it was possible that the same thing would happen here as had happened in Australia and that strains not so lethal for rabbits would develop. There was no evidence yet that this was so; an eye was being kept on the matter and strains were being tested to see whether they were showing any signs of diminution in virulence, but so far there were no signs that anything of that kind was happening.

Dr. Montgomerie raised the question whether resistant rabbits would tend to breed resistant rabbits. There was of course always the possibility that the resistant doe would transmit antibody to her offspring and there might be resistance in the young while they were still sucking from their dams, but there was no likelihood of the transmission of any more permanent form of resistance. This might develop over a matter of a number of years. His own feeling was that resistant rabbits would not develop for very many years.

The laboratory was looking to see how many immune rabbits were left behind in the different areas where the disease had passed. So far over 100 samples of serum had been examined and two rabbits had been found with a high titre of antibodies, one very early from Sussex, and another recently from West Suffolk. Seven had had a very low titre of complement fixing antibody which it was thought must have been due to an attack of the disease, although one was a little at a loss to explain why the titre was so low so soon after infection. One rabbit was from Anglesey and six from West Suffolk. In all, therefore, there had been nine positive rabbits out of about 107 samples.

The matter of other species of animals or birds being affected with myxomatosis had been considered at length and the laboratory was very anxious to obtain material from any other animals or birds which were suspected of having myxomatosis. Rooks, two hares, and a cat had been examined and in none of these cases had the myxoma virus been present. It was hoped that anybody who came into contact with any of these cases would send material to the laboratory so that the matter could be settled beyond doubt. There was not the slightest reason to suspect that any animal other than the rabbit, and perhaps the hare, could become infected by myxomatosis, but obviously it was a matter which should be checked at every possible opportunity. There was a possibility, judging from the French experience, that an occasional hare was susceptible, but the majority of hares were resistant. It had not been possible to inject hares experimentally, even when material from a hare which was said to have died of the disease had been used.

Mr. Ritchie, also in reply, said he had found that collaboration with others in the preparation of a paper was very commendable but when it came to replying to a discussion it did not leave one very much to say. He was extremely interested in Professor Glover's speculations as to how this disease was spread in this country. He would like to say that anything which had been said by him or in reply to the discussion did not in the slightest degree imply that there was any intention, at the moment at any rate, of doing anything willingly to spread this disease. He thought that all veterinary surgeons would agree that it could not on general grounds be commended that a disease of this nature, or any other nature, should be used in this way.

He was inclined to adhere to the opinion which was expressed, not very dogmatically, in the paper that in fact what would happen in this disease in this country was that a stage would be reached when there would exist both the disease and the rabbits. In point of fact it might vary from season to season in its degree of spread and it would also vary with the extent to which human agency was involved in spreading the disease from one locality to another, and this could not be controlled.

He would emphasise that it would be of tremendous help if there were suspicions of the disease in hares that the material should be sent to Mr. Hudson so that the doubt could be resolved. He was rather surprised that Dr. Wooldridge did not take the opportunity to have that doubt removed as effectively as he had removed some other doubts.

Everybody concerned would be extremely interested to observe how this virus disease behaved in the conditions of this country and it would be interesting to make comparisons with other countries where the disease had been induced, and to see whether it was indeed the fact that different conditions did have the effect which workers were inclined to forecast.

The Chairman thanked the authors of the paper and those who had taken part for a most interesting discussion.

A NOTE FROM KENYA

A pleasantly informal ceremony took place recently on the platform at Nairobi station. It was the occasion of the departure from the Colony of Major H. H. Brassey-Edwards and Mrs. Brassey-Edwards. On behalf of the Kenya Veterinary Association, the Director of Veterinary Services, Mr. R. A. Hammond, presented to Major Brassey-Edwards a piece of inscribed plate. The inscription expressed grateful tribute to his many years of untiring effort on behalf of the profession in Kenya. With the gift go abundant and affectionate good wishes for Major and Mrs. Brassey-Edwards's future.

FOURTH CONGRESS PAPER

A Review of Some Technical Aids in Veterinary Radiology

BY

J. HICKMAN

Department of Veterinary Clinical Studies, University of Cambridge

This Congress paper was discussed during the latter part of the morning of September 22nd. The Chairman was Mr. K. G. Morgan, M.R.C.V.S., and the recording secretary Mr. D. W. S. Pettett.

The Chairman said that this paper was a review of some of the technical aids in veterinary radiology and Colonel Hickman would introduce his paper and show some slides.

Colonel Hickman: First of all, I would like to thank you for the honour you have done me by inviting me to address you to-day.

I think there has been a little misunderstanding concerning this paper, as it was originally advertised in THE RECORD as "Radiology as an Aid to Veterinary Diagnosis." When invited to give this paper it was suggested that I should say something which would be of assistance to veterinary surgeons in practice who were considering the purchase of an X-ray unit or who had a unit but were not too happy with the results they were achieving. With this in view I thought the best method of approaching the problem was from the angle of how to obtain good radiographs rather than to show a series of slides depicting numerous conditions which can be diagnosed radiologically. Once good radiographs can be obtained the diagnosis is comparatively easy.

The paper, which follows, was illustrated by a series of lantern slides.

THE PAPER

Colonel Hickman's paper, which had been circulated previously, was as follows :—

Introduction

THE purpose of this communication is to assist veterinary surgeons who have their own X-ray units. Therefore, it is proposed to cover in a general manner the production and properties of X-rays, X-ray units, X-ray films, intensifying screens, the use of various film and intensifying screen combinations, the use of grids, dark-room practice, and methods adopted for carrying out routine X-ray examinations of the skeletal system and soft structures in both large and small animals.

Since the majority of units employed by veterinary surgeons in practice have a limited output, emphasis will be placed on those techniques which will enable them to obtain the most satisfactory results within the limit of their units. Perhaps the most difficult feature in veterinary radiology is to cope with movement of the patient. With powerful units this is partly achieved by being able to employ very short exposure times. Using smaller units it is often necessary to resort to the use of fast films and intensifying screens, but these measures reduce definition and contrast and the final product is not always all that may be desired.

Finally, it must be appreciated that a radiograph is merely a "shadow" and can only demonstrate the outline and changes in density of structures and tissues.

X-rays

X-rays are generated when a stream of electrons travelling at a high speed are suddenly stopped, and I think their production may be most satisfactorily explained by describing an X-ray tube.

An X-ray tube comprises an evacuated glass bulb into which are sealed two electrodes (anode and cathode). A source of electrons is obtained by heating a coil of wire incorporated in the cathode, and they are set in motion by applying a high potential across the electrodes. The cathodic electrode is shaped to form a concave focussing cup which directs the electrons in a concentrated beam on to the anode, resulting in the production of X-rays. The anode is made of tungsten set in a block of copper which serves to carry away the heat produced when the tube is in operation. This problem of dissipation of heat is a very critical one in the manufacture of X-ray tubes and is partly overcome by having the tube immersed in oil, and in high power units by having the anode rotating. The surface of the anode against which the electrons strike is called the "Focal Spot" or "Focal Area" of the tube.

The two most important factors to be considered in the production of X-rays are voltage and amperage. The mains current used to supply an X-ray unit has the voltage stepped up and the amperage correspondingly reduced so that these factors are measured in kilovolts (KV) and milliamperes (MA) respectively. The higher the KV the faster the electrons travel and in consequence the harder they strike the anode. This results in the production of X-rays of short wave length which have greater penetrating powers. This factor affects the contrast of the radiograph. The higher the MA the greater the number of electrons moving from the cathode to the anode. This factor affects the quantity of X-rays produced and therefore the density of the radiograph.

When making an exposure three factors have to be considered, i.e., KV, MA and time. Once the correct KV has been determined to obtain the required degree of penetration it is then necessary to select the correct MA, combined with the time of the exposure, to obtain the optimum degree of density. It is frequently an advantage to consider MA and time as one factor by multiplying them together and referring to it as milliampere seconds (MAS).

In the larger units KV, MA and time are all controlled separately, but in the smaller units the KV and MA are generally linked under one control, and only the time factor is completely variable. The manufacturers supply a chart with each unit giving the KV and MA ranges, but as the KV rises so the MA drops. However, in some of the portable units, the MA is kept standard, usually about 15 MA, and both the KV and time are variable.

X-rays have properties very similar to light. They are invisible, travel in straight lines, pass through matter with varying degrees of intensity, fluoresce certain substances, affect photographic emulsions, and may either stimulate or kill living cells.

The amount of radiation reaching the sensitive emulsion of the film determines the density of the image. In addition to current, time of exposure, etc., the density is influenced by the distance the X-rays have to travel from the anode to the film. This distance is referred to as the Focal-Film-Distance (F.F.D.). As the X-rays travel from the anode they diverge and in consequence cover greater and greater areas with decreasing intensity. In this respect they conform to the laws of light, and the intensity of the radiation varies inversely as the square of the distance. The practical application of this law is that if the F.F.D. is doubled then the exposure time will have to be increased four times to obtain a radiograph of identical intensity. Under normal working conditions an F.F.D. of 30 inches will be found satisfactory.

Since a radiograph is essentially a "shadowgraph", the position of the object in the path of the X-rays relative to the film has to be considered. To reduce distortion of the image to a minimum the object should be as close as possible to the film and the source of the X-rays as far from the object as practicable. It has been found that for the latter 30 inches is quite satisfactory provided the "focal spot" is small.

Films

An X-ray film is a complex and delicate structure. It is composed of a cellulose ester base covered with a dry granular silver bromide emulsion with a protective supercoat. The action of the X-rays or light is to render some of the silver-halide grains in the emulsion developable, which means that chemically they can be reduced to metallic silver. This reduction to metallic silver is brought about when the film is placed in the developing solution. However, the developed image cannot be seen clearly because of the remaining unreduced light sensitive silver-halide grains in the film. These are dissolved out in the fixing solution thus leaving the developed image visible.

The speed, contrast and details obtained with various X-ray films depends on the types supplied by the manufacturers. There are three main types on the market (i) *Non-Screen Films.* These are supplied envelope-wrapped and are for use without intensifying screens. They are high contrast films which are excellent for bone detail, and especially useful in small animal work for all bones and joints which can be brought into close contact with the film and not surrounded by a thick mass of muscle. (ii) *Standard Films.* A good all-round film for general radiography, is for use with intensifying screens and gives good contrast and definition. (iii) *Fast Films.* As a rule these are about twice as fast as the standard films but of a slighter softer gradation lacking contrast. The high speed of such film permits short exposures and therefore greatly increases the scope of the low power units.

Films should be handled carefully from the time they are received until they are developed and dried. Boxes of films should be dated when received, stored on edge, protective paper folders should not be removed until the film is being loaded, and care should be taken that they are not exposed to X-rays or light.

Intensifying Screens

No matter how sensitive the silver-halide emulsion of the film only a small percentage of the energy in the X-ray beam can be utilised. This may be overcome if some of this unused energy can be absorbed and converted into another form of energy which will act more efficiently on the emulsion. Certain compounds when exposed to X-rays fluoresce with a colour to which photographic emulsions are sensitive. This then forms the basis of intensifying screens because by placing such materials in close contact with a photographic film and exposing both together to X-rays, the fluorescence of these materials reinforces the action of the X-rays on the film.

Intensifying screens are composed of cardboard or a celluloid waterproof card base in which the fluorescent materials are incorporated and covered with a thin protective film. They are used in pairs one on each side of the film.

The fluorescent materials in common use are calcium tungstate, barium lead sulphate and zinc sulphide. The latter which is used in *Fluorazure* screens, produces a rather persistent afterglow and although modern screens containing this salt are specially treated to overcome this disadvantage they are not entirely free. It will be seen that intensifying screens have very definite advantages. By their use exposure time may be reduced which in turn assists in overcoming patient movement, reduces the dose of X-rays received by the patient, and increases the life of the X-ray tube. In the manufacture of intensifying screens the intensifying factor, definition, and degree of afterglow have to be considered in relation to the KV employed. Unfortunately it has been found that the factors which contribute to high speed reduce definition and *vice-versa*. The manufacturers have produced a variety of screens to cover these variations.

The Standard screen gives good definition and contrast over all ranges of KV consistent with the greatest possible speed. The High Definition screen, as its name implies, gives better definition than the former but requires an increase in exposure time. The *Fluorazure* screens are very fast but do not produce good definition and produce afterglow. Finally there are the High Voltage Screens which between 80 and 120 KV give a clarity to the final product equal to that of the Standard screen and in addition are approximately 50% faster. It is customary for all general purposes to use Standard screens but if extra definition is required a High Definition Screen or a non-screen film may be employed. However, it seems to me that the High Voltage Screen produces a final product with a definition and contrast equal to the Standard Screen and has the added advantage that it is very much faster thus permitting exposure times to be reduced. Intensifying screens should be treated carefully and kept clean as lack of attention may result in artefacts on the film.

It will be seen from the above remarks concerning films and intensifying screens that definite combinations have to be selected for specific purposes. The main difficulty when using low power X-ray units is to be able to make an exposure fast enough to overcome movement of the patient. Even when the patient is anaesthetised one has to contend with movements of respiration and those caused by the heart beat. Therefore the radiologist is continually competing with the time factor. To a degree this may be countered by using a fast film and intensifying screen, but as this factor is increased the final product suffers from lack of contrast, definition, and detail of the radiograph. However, in those conditions which do not require very fine definition to enable a diagnosis to be made, such as fractures and dislocations, this combination has a very definite application.

Grids

When X-rays pass through matter or strike an object some scatter, and the degree of scatter is dependent on the density of the tissues. Scatter produces a deposit of silver in the film in addition to that forming the image. This results in lack of contrast and clarity which may be overcome by placing a grid between the patient and the film.

Basically a grid consists of sheets of non-opaque material interleaved with thin strips of lead foil. By this measure the X-rays which are not deviated from their course pass through unhindered on to the film, but those that scatter are stopped by the lead strips. When grids are employed the exposure time has to be increased three and a half times and the lead strips show as fine lines on the radiographs. The presence of these lines on the film may be overcome by having the grid moving during exposure. A mechanical arrangement to do this was invented by Drs. Potter and Bucky. It is now universally known as the Potter-Bucky Diaphragm and is incorporated in standard X-ray tables.

In addition to grids, scatter may be reduced by using diaphragms or cones to restrict the X-ray beam to the precise area required on the film. Zoning off the area to be X-rayed with lead sheeting is useful and especially for A/P spines. Scatter from the X-ray table is overcome by a sheet of lead being incorporated in the back of cassettes, but when using envelope-wrapped non-screen films it is necessary to place them on a sheet of lead or lead-rubber mat.

It is practically impossible to obtain satisfactory radiographs of dense areas without the use of grids, and this again greatly limits the range of low power units due to the increase of exposure time required.

Dark Room Practice

Unless care is taken to ensure that dark room practice is of the highest standard the final radiographs will be far from satisfactory. I consider that standard processing should be adopted which not only assists in reducing variables to a minimum but is really the only way to predetermine correct exposures.

The majority of dark rooms are far too small and should be at least of such a size that separate dry and wet benches can be used. The dry bench should be kept solely for loading and unloading cassettes, the wet bench being used for processing. The darkroom should have adequate ventilation, a good water supply, be kept free of dust and chemicals, provided with the necessary safety lights, and blacked out. It is quite unnecessary to have the walls blackened, in fact the lighter they are the better, as the reflection of the safety light from light coloured walls makes it much easier to recognise objects and thus improves working conditions.

Processing brings to completion, by chemical means, the changes initiated in the emulsion of the film by the X-rays. The film is processed through the following five stages.

Firstly it is developed, that is to say it is placed in a solution (the developer) which brings about a chemical reduction of the developable silver-halide grains to metallic silver. It is then rinsed to remove any excess developer retained superficially by the gelatin. Next the film is placed in the fixing solution which being acid arrests further developing by neutralising the alkaline developer and renders clear the unexposed portion of the film by dissolving out the undeveloped silver-halide remaining in the gelatin layer. It should be noted that fixation is not complete when the film has cleared because the fixing solution contains a hardening agent to toughen the gelatin layer and this takes at least ten minutes to act.

Finally the film is washed to remove all chemicals from the gelatin layer and then dried.

During processing particular attention must be paid to time and temperature, and to obtain consistent results it is advisable to keep them standardised.

Developer and fixer solutions will not maintain their efficiency indefinitely. With the former there is a progressive loss of density and contrast, and the latter takes longer to clear the film. To remedy this the developer should be restored periodically as near as possible to its original condition by the

addition (topping up) of recommended replenisher solutions. If fresh solutions of developer are used for this purpose a tank of uncertain activity results. When developing solution begins to deteriorate it should be discarded and a fresh solution prepared rather than attempting to offset this by increasing the MA for density and decreasing the KV for contrast.

The temperature of the developer and the time the film should remain immersed must be strictly followed in accordance with the manufacturers' instructions. The usual recommendation for standard developer is for 5 minutes at 68°F. (7-8 minutes for non-screen films), but the time of immersion required due to changes in the temperature of the developer can be calculated from a Time-Temperature Chart which is a most useful part of the equipment in every dark room.

When large numbers of films are being developed daily it is customary, when making up a fresh supply of developer, to make up an equal quantity of replenisher solution and when this has been used up to discard the developer and start afresh. This is not practicable in the average veterinary practice due to the small number of films that are developed, and in consequence there is a gradual and continual oxidation of the developer taking place which renders it below the required standard in from 2 to 3 months.

During processing a film should be agitated periodically to remove air bubbles, and not inspected until it has been in the developer for at least one minute or the fixative for 30 seconds. Films should be immersed and withdrawn from the solutions slowly, and allowed to drain for 10 seconds before being taken to the next stage of the process.

It is surprising how quickly the temperature of the developer falls and care should be taken to record the temperature before each batch of films is put through and the optimum time for development calculated.

Again it is emphasised that development should be kept standard, and it is much more satisfactory to make another exposure rather than try to improve an over-exposed film by under-development or an under-exposed film by over-development.

To obtain radiographs of a high standard all these points must be appreciated and varied to meet the numerous problems that arise in relation to the subject and the unit available.

Skeletal System

When taking radiographs special attention has to be paid to accurate positioning, alignment of the tube, and control of patient movement. The part to be radiographed should be placed directly over the centre of the film and the tube adjusted so that the central rays pass at right angles through the centre of the film.

Movement may be controlled by placing the animal in a comfortable position. The use of sandbags, and, under certain circumstances, narcotics or a general anaesthetic may be necessary.

Radiographs should be taken in two planes, and on occasions it is advisable to take similar radiographs of the opposite limb for comparison.

In the dog, radiographs of the limb bones and joints present little difficulty. However, the following procedures have been found useful. Dental films are useful for lateral views of individual digits as they can be placed in close contact to them, thus overcoming distortion. Antero-posterior views of the elbow joint may be taken conveniently with the dog in the standing position. Lateral views of the shoulder joint may be obtained by placing the dog on its side with the shoulder joint to be radiographed in contact with the cassette and the upper forelimb pulled well back. Antero-posterior views of the hock joint may be obtained by placing the dog on its back with the metatarsus held flat against the cassette. The stifle joint deserves special attention as injury to both cartilages and cruciate ligaments frequently occur, and special techniques are required to enable a clinical diagnosis to be confirmed radiologically. The most important point to be considered is the position in which the joint should be placed to show the maximum joint space. In our experience the best results are obtained by having the joint flexed at an angle of 120 degrees over a curved cassette and the tube aligned at right angles to the tibia. To enable the cartilages to be demonstrated it is necessary to inject a contrast medium into the joint space, and for this we find air to be the most satisfactory. Prior to the injection of from 15 to 30 ccs. of air into the joint space tourniquets should be applied both above and below the point to prevent air either entering the suprapatellar pouch or escaping into the subcutaneous tissues.

In the horse satisfactory radiographs may be obtained of all bones and joints from the knee and hock downwards. In some cases satisfactory radiographs may be obtained of the elbow and stifle joint with the horse in the standing position, but if the horse is recumbent then radiographs of these and the shoulder joint can be obtained of high diagnostic value.

The navicular bone is frequently the seat of disease which requires radiological examination to confirm a clinical diagnosis, and in my experience it is difficult to obtain radiographs of certain diagnostic value. Prior to taking the radiograph the shoe should be removed, foot taken down, frog and sole trimmed and then scrubbed with a stiff brush to remove all dirt, gravel, etc., special attention being paid to the frog clefts. It is a matter of choice whether or not the frog clefts are packed with a paste of powdered horn and vaseline to obtain a more even density of the whole foot. The foot should be placed in an upright position and the tube aligned so that the X-rays pass through the navicular bone at right angles to its anterior surface. A high KV is not necessary to obtain good radiographs of this bone. Use a KV which gives the necessary penetration and sufficient MAS to blacken out the surrounding structures, thus obtaining maximum contrast of the bone itself. In addition, the use of a grid is imperative if radiographs of the highest diagnostic value are to be obtained.

Movement of the horse always presents difficulties, and movement of the cassette should be controlled

by resting one edge on the ground or placing it in a cassette holder. Another difficulty of taking radiographs of regions below the fetlock joint is that in the majority of X-ray units the tube cannot be lowered sufficiently to permit the rays to be directed through them at right angles. This may partially be overcome by placing the foot on a block, or better still by having the horse on a ramp.

It is customary to take radiographs of the vertebral column of animals both laterally and anteroposteriorly. Due to the thickness of tissues the rays have to penetrate, there is considerable scatter which can only be overcome by using a grid. It is not easy to obtain accurate positioning when taking A/P radiographs, especially in unanaesthetised dogs, but this may be overcome by restraining the animal in a trough.

Except in very small ponies it is practically impossible, even using the most high powered units, to obtain radiographs of diagnostic value of the vertebral column with the exception of the cervical or caudal vertebrae.

Soft Tissue Technique

It is often hoped that a clinical diagnosis may be confirmed by producing a radiograph which shows differentiation between or within soft tissue, in addition to showing the mere outline. This is not easy and requires special techniques owing to the slight difference in density between the structures.

A common practice is to use a very low KV, 45 to 55, maximum MAS or non-screen films. This technique is useful for demonstrating such conditions as pregnancy, pyometritis, intussception, enlarged mediastinal lymph glands, heart, diaphragmatic hernia, and for the larynx and trachea. The outline of the latter is greatly improved because of air within the lumen acting as a contrast medium.

Contrast Media

To enable the alimentary, urinary tract, etc., to be visualised radiographically they must contain a radio-opaque substance so that their outline can be differentiated from the structures surrounding them.

Alimentary Tract

Bismuth was the first contrast medium used for examination of the oesophagus, stomach and intestines, but now has been replaced by barium sulphate. This has to be administered as a suspension, and to prevent clumping of the barium the commercially produced suspensions contain a protective colloid. In the dog a dose of from 4 to 8 oz. is sufficient to fill the stomach, but when it is desired to empty the stomach rapidly to demonstrate some abnormality in the small intestines a smaller dose of from 1 to 3 oz. is preferred.

Barium suspension may be administered either by the mouth or by stomach tube, and when possible all food should be withheld for 12 hours. Its main use is to demonstrate foreign bodies. Those obstructing the oesophagus are easily demonstrated, but care has to be exercised, if they are non-opaque, especially in the stomach. In such cases it is advisable to examine the area after the stomach has emptied when the foreign body will be shewn up due to its coating of media.

As it outlines the whole of the oesophagus when given by mouth it satisfactorily demonstrates strictures or dilatations due to neoplasms or injuries.

In the normal dog the barium suspension commences to leave the stomach within 15 to 20 minutes following administration and should be present in the colon within 6 hours. If it has not passed through within 6 hours an obstruction is highly probable.

Urinary Tract

Visualisation of the bladder presents little difficulty in either the dog or cat as it can be catheterised, except in the female cat. After the bladder has been emptied it is filled with a 20 per cent. solution of sodium iodide made up in distilled water.

To outline the structures of the kidneys and ureters presents a more difficult problem. If the medium is injected into the pelvis of the kidney via the ureters it is spoken of as retrograde pyelography. In the smaller domestic animals anatomically this is not easy, and in addition it should be noted that this method gives no indication of function. Therefore one has to employ an excretory method which is called descending pyelography. This entails the intravenous injection of a radio-opaque substance which is excreted in the urine and outlines the kidneys and ureters without invading other tissues.

Water soluble organic iodine compounds are the media most commonly employed for pyelography. These compounds have a complex molecular structure which consists of two parts. One, the "carrier", which ensures that the agent goes to the organ to be examined, and the other part, which carries the iodine, and therefore controls the opacity. The two most commonly employed are iodoxyl and diodone. They are manufactured under a variety of trade names and put up in strengths varying from 20 per cent. to 70 per cent. W/V. They are both rapidly excreted unchanged, with their maximum concentration appearing in the kidneys within 15 to 30 minutes following injection.

To obtain satisfactory pyelograms all food and water should be withheld for 12 hours, an enema administered and the dog anaesthetised. 5-20 ccs. of a 50-70 per cent. W/V solution of iodoxyl or diodone at body temperature should be administered by slow intravenous injection, and radiographs taken, with the dog placed dorso-ventrally, at 5, 10, 15 and 20 minute intervals.

To prevent the too rapid excretion of the media into the bladder some workers recommend compression of the ureters by pads or a bandage.

To enable the cassettes to be changed without moving the animal it is necessary to employ a special cassette holder, made of non-radio-opaque material, on which the animal is positioned and under which the cassettes are slid.

When viewing pyelographs it should not be forgotten that the two kidneys do not always function in unison and if one only is outlined it should not be presumed that there is a renal insufficiency of the

other. Satisfactory pyelograms cannot be obtained without the use of a grid or Potter-Bucky diaphragm.

Spinal Canal

Myelography is the visualisation of the spinal canal and outlining of the spinal cord by injecting a contrast medium into the cerebrospinal fluid. The medium used for this purpose should be non-toxic, non-irritating, mixible with the cerebrospinal fluid and easily eliminated.

The common contrast media used for myelography are :—

1. Iodised oil. This gives a very good contrast but tends to break up into globules. This drawback may be lessened to a degree by ensuring that the oil is injected at body temperature. It is only slowly absorbed.

2. Ethyl iodophenylundecylate. This is an iodinated lipoid of low viscosity. It does not give such a good contrast as the Iodised oil but has less tendency to globulate and approximately 50 per cent. disappears in a year.

3. Thorotrast (colloidal thorium dioxide). The use of this medium has been fully reported on by Olsson in Sweden but has not been accepted by many workers because it is somewhat irritant, is radio-active, and has to be eliminated by forced drainage.

These media may be either injected into the subarachnoid space or into the cisterna magna, the latter route, using the technique described by Brook, being the more convenient. When making a cisternal puncture the head should be kept fully flexed and the needle inserted at right angles to the dorsal line of the neck. After the cerebrospinal fluid has ceased to drip from the needle the contrast medium should be injected slowly and at body temperature. To prevent the medium entering the subarachnoid space of the brain and to facilitate its flow down the spinal cord the dog should have its head raised and the table on which it is lying tilted to an angle of about 30 degrees.

It is hoped that the above remarks have put into a concise form the essential features that have to be considered in veterinary radiology. The broad approach to the subject has resulted in a lack of specific detail, and without doubt much of special interest to individuals has been left out. It has not been considered necessary to devote space to individual exposure factors and to meet this criticism a list of exposure factors as a guide is attached.

Summary

1. The properties of X-rays have been briefly discussed and the importance of KV, MA, time and Focal-Film-Distance (F.F.D), on the contrast and density of the radiograph pointed out.

2. The advantages and disadvantages of various types of films and intensifying screens and their combinations has been reviewed.

3. The problem of " scattered radiation " and its control by grids and cones has been shown.

4. The essential features of darkroom practice and the processing of films has been outlined.

5. The technique of taking radiographs of the skeletal system in small and large animals has been briefly discussed but with particular attention being paid to the stifle joint in the dog and the navicular bone in the horse.

6. Details have been given of the types of contrast media commonly employed for outlining the alimentary and urinary tract and the spinal canal.

7. A table of exposure factors is attached.

EXPOSURE CHART
FOR 90 KV. 50. M.A. UNITS

Region	Film	KV.	Time	Screens	Grid
Extremity. Cat, Small Dog	Non-Screen	65	0·2 seconds	—	—
Extremity, Large Dog	Non-Screen	65	0·3 seconds	—	—
Skull, Cat	Non-Screen	75	0·5 seconds	—	—
Abdomen, Cat, Small Dog	Standard	65	0·3 seconds	Standard	—
Spine, Cat, Small Dog	Standard	70	0·3 seconds	Standard	—
Pelvis, Cat, Small Dog	Standard	70	0·3 seconds	Standard	—
Skull, Dog	Standard	65	0·2 seconds	Standard	—
Spine, Lat, Cat	Standard	70	0·2 seconds	Standard	—
Navicular, Horse	Standard	80	0·5 seconds	Standard	+ Stationary or moving
Carpus, Horse	Standard	80	0·5 seconds	Standard	+ " "
Hock, Horse	Standard	80	0·5 seconds	Standard	+ " "
Spine, Large Dog	Standard	80	0·5 seconds	Standard	+ " "
Pelvis, Large Dog	Standard	80	0·5 seconds	Standard	+ " "

All the above exposures are based on a standard Anode-Film distance of 30 inches.
High Speed Films reduce exposures to one half, and are especially useful where dense structures are to be examined, *i.e.*, in all large animal work.

THE OPENER'S SPEECH

Mr. R. C. Crowhurst, O.B.E., M.R.C.V.S. (Newmarket), opening the discussion, said: I am greatly honoured at being asked to open the discussion on this very interesting paper and on the slides which Colonel Hickman has shown us. Originally it was supposed to be a paper on X-rays and diagnosis and that was why I agreed to open the discussion. As you can see from the paper, it has developed into a matter of technique and I feel myself in rather a false position because I know little about this. Colonel Hickman says that the paper was written with the idea of assisting practitioners who have their own X-ray apparatus but I think it will be of more particular use to practitioners who have just acquired a set, to recent graduates going into practices where X-ray apparatus is available and to those who have not had much previous experience.

Veterinary radiology is essentially a very practical thing and is something of an art which can be acquired only by experience. It entails not only all this technical knowledge but some knowledge of actually handling animals, getting limbs into position and so on for obtaining the best pictures. It entails practice with one's own set, no-one can expect to produce any decent results until he has had some experience of the set he is trying to use and of its own vagaries. Our own set seems to vary quite a lot, as does the power of the mains in some outlying districts. It also requires some experience in the reading of plates after taking good pictures and getting used to a kind of "flat anatomy." Good records of one's very best plates should be kept of time, KV and other factors because they are useful for comparison later, and for working out the best technique with one's particular set.

The actual paper which Mr. Hickman has written deals very fully with all the technical aids, and as such I find there is little in it to criticise. I will, however, attempt to fill in some of the more practical details which he has not had time to do in the paper or in his talk and I propose to deal only with the large animal because I have not had very much experience with small animals. I am sure there are others present who can speak with a great deal more experience than I have had of small animals.

Not all successes are due to technical equipment, it takes a little experience of handling animals, particularly horses, and allaying their suspicion of strange surroundings. An X-ray set for a practitioner must be portable because there are occasions when it must be taken to the patient but I would advise that whenever possible the patient should be brought to the place where the dark room is. There is nothing worse than motoring some distance to take the plates, driving back to the surgery to develop them and then finding one has not got what one wants.

Horses must be radiographed in the standing position, and they must be handled firmly and quietly and their apprehensions allayed if possible. No doubt it is better if it can be so arranged that they do not see the set, they will stand much more quietly. We have a system of two stable doors cut into two on which can be fixed a movable manger. We deal with the lower limbs mostly in horses and one can work with the lower door open with the horse standing with his head to the closed top door with the manger in position. He does not see the set at all and I am sure that is a great advantage. Some people stand horses in stocks. It does make them stand still but I do not favour the method as horses who have never been in stocks or in a confined space are liable to get upset when they cannot move freely and they become more excited than is necessary and occasionally a nasty accident can happen.

In most cases I do not think it is necessary to restrain an animal. Occasionally a horse will not stand still and the application of a twitch makes a great difference for a few minutes. The contact mechanism on some sets is designed for human beings and it makes rather a loud click and if you can get a soundless, or almost soundless one, it is a great advantage. We have ruined many plates after having everything just right and the click of the switch making the horse move at the time of exposure. This is a point which should be studied a little more by the makers of the machines.

Colonel Hickman has stressed the time of exposure, keeping it low for large animals on account of movement and that is correct. The urge for speed does not enter into it with small animals but it is surprising how long one can get a horse to stand still. With our set we have to make exposures up to two seconds and up to that time it is possible to get very good results. I do not agree that it is all a matter of speed. The price of a small film is 1s. 7½d. and if there is movement during one or two exposures it is not such a terrible loss. The movement of animals is of two types: the voluntary movement which can be overcome and the trembling movement, which is so difficult to control, in animals suffering a great deal of pain as from a recent fracture.

With regard to films and screens, it has been our practice to use standard film and standard screens and satisfactory results can be obtained with them. I would advise using as small a film as possible, the 10 by 8 inches size is usually quite large enough and has the advantage of allowing one to get the cassette much closer to the actual site being X-rayed. I would suggest marking the films with a serial number or letter because it is so easy to muddle them when developing. It is also important to mark the outer or inner side of the limb.

I have not tried the high voltage screens which Colonel Hickman mentioned. There is no doubt that grids are essential when a thick part or a thick bone has to be X-rayed to prevent scatter. The flat type grid which fits on to the cassette is much better than the older type which are concave or convex and are not so easy to keep still on the cassette. A frame which will hold the cassette and grid together is very useful indeed. I notice that Colonel Hickman in the paper says that the exposure time should be multiplied by three and a half times when grids are used. In our experience that has not been necessary and I would like to ask Colonel Hickman how he arrived at that figure; I find it needs usually only twice the amount of time. In large animals it is rather a problem getting a standard distance from the centre of the tube to the film. It is also rather difficult sometimes to make sure that the centre of the beam is pointing directly at the spot which it is required to X-ray. There are direction rods which can be screwed on to the front of the tube and extended to bring it against the part to be X-rayed but they are dangerous when dealing with horses because if it is too close to the horse's leg and he moves he is liable to hit the projection rod and damage the tube. To overcome this difficulty we have had two lights constructed and put on either end of the tube, about 18 inches apart, fixed so that they intercept 28 inches from the centre of the tube and in the centre of the beam. They can be attached to an ordinary battery and this gives an easy and simple system of ensuring that the tube is at the right distance. It is also possible in this way to make sure that the beam at the time of exposure is pointing at the dead centre of the part one wishes to see. It assists in the speed of taking the X-ray picture by avoiding making constant measurements. Any electrician could fix such lights and I would strongly advise some such device with large animals. It sounds complicated to assess KV, amperes and time and from a large animal point of view for X-raying limbs we keep everything constant, except time, and one can soon judge how much exposure time is needed for the various bones.

Colonel Hickman notes that satisfactory X-rays can be obtained in the horse from the knee-hock downwards but I think it is possible to take very useful X-rays of the radius, ulnar, tibia and patella. But the back, pelvis, femur, and hip joint are difficult and beyond the powers of ordinary sets. I have never seen a really good X-ray of a horse's femur or pelvis.

The foot is probably the commonest area in a horse to be X-rayed and Colonel Hickman has stressed quite correctly the need for the very careful cleaning, the removal of the shoe, etc., before attempting it. Colonel Hickman doubts whether a positive diagnosis of navicular disease can be made. I am sure it can; one has taken good films of navicular disease and there is no question of doubt about it; later it is proved on *post-mortem* examination. One does have to X-ray many horses with chronic foot lameness in which no lesions can be shown of the bones of the foot but I do

think this failure is not due to bad or faulty technique, but it is just that there are many horses which are chronically lame in the foot in which there are no bone lesions. Blocking out the frog and lateral clefts, he says, is a matter of choice but in my experience it is essential. I do not think it is possible to make a diagnosis of a fractured navicular bone without doing so because one gets the shadows of these clefts coming over the area where the navicular bone usually fractures.

The position of the forefoot is rather important because it is desirable to get the navicular bone fairly high up on the back of the oscorona. If the foot is too far forward the lower edge of the navicular bones goes along the junction of the coronopedal joint and this is the edge which one often wants to see. We take the foot 3 inches off the ground, held in a small wooden block resting on the toe. The centre of the tube is 15 inches off the ground and if the foot is only 12 inches in front of the other you will get the navicular bone in the best position. It is important to do both feet because sometimes one sees what appears to be a lesion on the lame foot and then is surprised to find the same on the sound foot.

For the pedal bone itself shorter time with less KV is needed. It is usually the very edges of the pedal bone which one wishes to see in cases of pedal ostitis. In the hind foot there is no navicular disease but one occasionally wishes to see this bone where a fracture is suspected. The X-ray has to be taken from behind and the process is reversed. The leg is held with the toe raised on a wooden block 9 inches off the ground, the machine being behind the horse and the plate in front of the hoof.

X-raying canons and pasterns: here there are often cracks (suspected) and if it is decided to X-ray them I do stress taking them in several different planes, all A/P planes but at slightly varying angles. It is easy to miss a cracked pastern unless one happens to strike the true line of the crack with the beam.

If one is looking for arthritic conditions or exostosis it is necessary to cut down the exposure time because it is not desired to take the substance of the bone; all one wants is to see the small exostosis around the joint. In the light horse you will be surprised to encounter something which looks and feels like a ring bone but on X-ray one finds that there is no exostosis at all.

Colonel Hickman did not mention the head but it is possible to take some instructive and interesting X-rays of horses' heads in the standing position. The really lateral view is not much good as one side is superimposed on the other. If one goes a little above and cut in at an angle of 20° with the cassette on the side which you wish to take, with the tube held at a corresponding angle, you can get quite good X-rays of one side of the head without the teeth of one side being on top of those of the other. This method is quite useful for diagnosing fractures of the jaw, examining the roots of the teeth and other abnormalities including the sinuses. I have not tried filling the sinuses with any contrast media to show them up and I do not know whether Colonel Hickman has tried it himself. I would stress the importance of taking both sides of heads to compare one with the other.

I have nothing to say about soft tissue techniques. They are not applicable to large animals. For suspected foreign bodies or bone sequestra I suggest that a mark is made on the leg by clipping off a little hair and holding a metal director on the spot; it shows up on the film and gives a much better idea of exactly where the foreign body lies and facilitates its removal.

In conclusion I again congratulate Colonel Hickman on his paper; he has marshalled a lot of facts very carefully and given them in a concise form. When one has had some experience of X-rays one tends to get satisfied and think that one is producing the best plates possible but a paper like this stimulates us all to try out a few different films, grids, etc., which will help us to improve our final results.

THE GENERAL DISCUSSION

Mr. E. P. Barrett (Guildford) said that there was a traumatic condition of the stifle of the cow which appeared to be damage to, or tearing of, the internal miniscus. Was it possible to come to some conclusion about the lesion by X-rays and if so was there any future in surgical interference? Most practitioners knew this condition which results in a chronically lame cow.

The Chairman asked a question about the importance of the shadow-shift technique. Could Colonel Hickman describe it in a few words.

Mr. J. S. Steward, D.V.S.M. (Nottingham), said that this was a subject of increasing importance but he believed that in some of the schools nothing was taught about X-rays or X-ray techniques. He suggested that it would be suitable that an association of veterinary surgeons interested in radiology should be formed partly for the study of, and improvement of techniques and also for the study of veterinary anatomy. Some practitioners might not know what was normal and the more one saw the more one doubted. He hoped some of the men in academic posts would take some steps about this. If such an association had a meeting once or twice a year it would be of considerable help.

He would like to draw attention to the danger to the person of X-ray exposures. When he bought a set it was of low output and in a very short time he noticed a difference in the hair growth on the face. Nowadays when owners brought their animals in he got them to hold them.

How were marks removed from intensifying screens? One recognised them when one saw them. With a small animal one could stop respiration for a second of two by placing a finger against the nostril and this gave time for a slightly longer exposure. He did find trouble in examining the spine, in a number of cases of traumatic paralysis one found no evidence of damage and sometimes he wondered if there was a condition of spinal concussion.

He hoped something could be done about forming a veterinary radiological society, there was a lot of knowledge scattered about in the country which was not being spread as it should be.

Mr. R. Wentworth Hartley (Petersfield) asked if wrapped film could be used for the curved technique.

THE REPLY

Colonel Hickman, in reply, said:

(*i*) He had only done a little preliminary work on outlining the sinuses of the horse's skull with a contrast medium. The chief difficulty was to distribute effectively the medium so that the whole of the sinus was outlined. This might be overcome by injecting the medium in the form of a spray.

(*ii*) When giving exposure factors it was customary to give figures that would tend to result in over exposure rather than under exposure. Even so, when a grid was used he found that satisfactory results were obtained by increasing the exposure time by three.

(*iii*) He thought his comments on the diagnosis of navicular disease had been misunderstood. Once bony changes were established it could be diagnosed radiologically but it was a difficult bone to X-ray and it was not always possible to obtain as good a picture as one might expect. He liked to diagnose the case clinically but was always pleased to confirm it radiologically.

(*iv*) He said he had no experience of the disease of the stifle joint in the cow described by Mr. Barrett. However, he was certain useful radiological information could be obtained concerning the condition.

(*v*) Stereoscopic radiography could be employed. It entailed taking two radiographs with a slight shift of the tube.

(*vi*) He considered that formation of a society of veterinary radiologists was worthy of consideration but suggested that if sectional meetings were introduced at the Annual Congress one might well be devoted to radiology.

(*vii*) The danger to persons holding animals was a most important consideration but could be overcome to a degree by having different persons holding the animals on separate days.

(*viii*) An envelope wrapped film could be used for the stifle joint but more satisfactory results were obtained by using a standard film in a curved cassette with high definition intensifying screens.

The Chairman thanked Colonel Hickman and the speakers for their contributions on this subject. It was good to reflect that Colonel Hickman was attached to one of the teaching schools and that this information would be instilled into those graduates who worked under his able tuition.

FIFTH CONGRESS PAPER

The Prevention of Enterotoxaemias in Sheep

BY

R. F. MONTGOMERIE and A. THOMSON
(Wellcome Research Laboratories, Beckenham, Kent)

This Paper was discussed by the Congress delegates on September 22nd. The Chairman was Mr. Peter Fisher and the recording secretary Mr. A. Mather.

THE Chairman, in opening the meeting, said he did not think either of the authors of this Paper needed much introduction. He would call upon Dr. Montgomerie to introduce it.

Dr. Montgomerie said that it would always be difficult to write a paper which was generally acceptable to a Congress audience. Mr. Thomson and he had tried to steer a middle course—to stick quite closely to the subject they were asked to speak upon and to present their ideas of what might be put into practice. Despite some effort in that direction it was an even chance that they had not succeeded in covering the ground as some would have wished.

No references and no acknowledgments were included in the Paper, and yet the ideas expressed on the prevention of enterotoxaemias in sheep were founded partly on the work of others and were largely built up with the co-operation of many veterinary investigation officers and practising veterinary surgeons. It was hoped that some of them would contribute to the success of the meeting.

Few of them in agricultural practice were without the experience of being called to a farm to be presented with a lamb or a sheep carcase for *post-mortem* examination. The anxious farmer quite commonly asked, "What is it?" and on many occasions one was tempted to reply, "A dead sheep!" The tendency was to proceed to a *post-mortem* examination and, having completed the examination, to adopt a wise mask and diagnose. One wondered, frankly, how often that diagnosis was fully justified without having had the assistance of the local Veterinary Investigation Officer and his reports on bacteriological examinations.

Dr. Montgomerie hoped no one would get up and say that the delay of a week or two in getting a report back rendered it useless. When one sent a specimen to a laboratory it mattered only to a limited extent whether or not it was going to be a help in the particular case. It was still valuable because it enabled a better opinion to be built up and put into practice in the future. But in an emergency one must proceed on the best clinical diagnosis that could be made, basing it on past experience, a careful *post-mortem* examination and the history of the flock. However, there were various conditions which might simulate pulpy kidney disease, and he was led to believe that hypomagnesaemia was one of them.

In this country enterotoxaemia must be regarded as a major cause of sudden losses in sheep, particularly in the lowland flocks and the seasonal incidence was extending. If that was accepted, they could pass straight into the field of preventive medicine. Dr. Montgomerie wanted to make it clear that he did not dispute that methods of management could reduce the incidence of enterotoxaemia. But these methods did interfere with the primary objectives of sheep farming—the production of mutton, lamb and wool of top quality and at low cost and prevented the full utilisation of leys. It was to be hoped, however, that that point would be challenged, if found unacceptable.

An attempt was made to determine the level of immunity which would prevent loss. He would not contend that the level suggested in the Paper was one which would always prevent enterotoxaemia. There was no occasion to attempt to produce an immunity that was likely never to be broken; the proper objective seemed to be to produce a good working level. First, there was the need to develop an efficient antigen. The provisions as to quality laid down in the British Veterinary Codex had simplified the definition of what that must be.

The current suggestions for the prevention of pulpy kidney disease by immunisation were set down in the Paper, and it was hoped they left a good deal of room for discussion and questions, particularly from their colleagues who had the very awkward job of interpreting those recommendations to meet conditions in practice and the even more awkward job of explaining away an occasional failure! It was accepted that, in these days of high labour costs, expenditure on vaccine might be quite outweighed by the difficulties in, and cost of, collecting the flock for injection. The recommendations in the Paper would have to be adapted to the variations in management practice from district to district, even from farm to farm, to avoid unnecessary gathering of the flock.

Dr. Montgomerie said that if he and Mr. Thomson had laid down a reasonable and sound guide to what might be done, and if Mr. Thomson could satisfy the enquiries and criticisms of contributors to the discussion then the production of this little paper and the holding of the meeting itself would be amply justified.

THE PAPER

The paper, which had been circulated previously, was as follows:—

WE believe the Organising Committee of this Congress wished to have the enterotoxaemias of sheep on the agenda, not beacuse there are some interesting new discoveries to report and discuss, but rather because these conditions are now more prevalent and of greater concern to the veterinary surgeon in practice. Although we have long been interested in this subject we have little ground on which to estimate the incidence of sudden death diseases in sheep beyond that indicated by the level of the demand for preventive inoculation. Certainly the demand for pulpy kidney antiserum and vaccine has increased markedly in recent years. This must, in part, be a reflection of the increased value of sheep and may also be related to the return of sheep to lowland farming, often on relatively young lays and fodder crops, conditions likely to increase the incidence of enterotoxaemia.

We were relieved when our subject was restricted to the prevention of enterotoxaemias, largely because we could say little regarding all the ætiological factors since they are still little understood. We must, however, give attention to ætiology before considering prevention. Although there is no qualification of the word enterotoxaemias in the title of the paper, that term in relation to sheep diseases has come to mean disease due to the absorption of a bacterial toxin from the intestinal tract. There may be enterotoxaemias of other origin and we certainly do not dismiss the possibility that sudden death in sheep is occasionally associated with the absorption of a chemical breakdown product or a toxic substance resulting from a heavy helminth infestation. Certainly in some samples of intestinal contents we have demonstrated a toxic substance which apparently was not of bacterial origin. However that may be, it would be best to confine our attention to-day to the true bacterial enterotoxaemias. Perhaps even there some qualification is necessary. In braxy there is a stomach wall lesion; possibly it is not a true enterotoxaemia. In lamb dysentery there is generally discrete ulceration or necrosis of the mucous membrane of the gut: possibly these lesions are largely caused by the necrotic toxin of *Cl. welchii* type B, although it is easy to demonstrate bacterial invasion of the gut wall. If we exclude these conditions, then we have left for consideration what we may term the classical enterotoxaemias: those in which there is for practical purposes no invasion of the carcase, at least until late in the disease.

This restriction still leaves an interesting and important field for discussion to-day. It is generally accepted that the common enterotoxaemia of sheep is that in which *Cl. welchii* type D is the bacterial factor, although there are farms and areas in which type C is more commonly encountered. There is as yet no evidence that other types in the welchii group are the cause of significant enterotoxaemias in sheep. There, then, is our definition of the conditions with which we will deal. We do not propose to introduce specific references, although we appreciate how much has been contributed to our knowledge in the last twenty years by veterinary research workers in New Zealand, Australia and, more recently, America, quite apart from work done in Britain.

Perhaps we should have a little further qualification of our subject title by considering what we mean here by prevention. It is generally accepted that these types of *Cl. welchii*, and particularly type D, are quite ubiquitous and present in the intestinal tract in a high proportion of normal sheep. None of the investigations so far reported have provided a satisfactory explanation of the circumstances which lead to their production of enterotoxaemia. It may be that the nature and quality of the herbage ingested or some factor which leads to bowel stasis is the precipitating cause which provides the opportunity for massive bacterial toxin production in the intestinal tract. If and when such factors are more fully understood there may be the opportunity to apply preventive measures other than those concerned with immunisation against the bacterial toxins. Possibly some management methods which reduce the risk of enterotoxaemia can be practised. Most which have been suggested entail the exposure of the lambs or sheep to conditions which checked their thriving —something which is undesirable. We must all have experienced the farmer's response to the suggestion that his flock with lambs 6 to 10 weeks old be moved to poor pasture as a means of reducing the incidence of pulpy kidney disease. For the purpose of this paper, we are, then, going to confine our attention to the practice of immunisation, both passive and active, as a means for preventing enterotoxaemia in sheep.

It may be advisable at this point to give some short description of the conditions we have in mind. If we use the term pulpy kidney disease to indicate enterotoxaemia due to *Cl. welchii* type D, we may avoid some confusion. This disease was first determined in forward lambs 6 to 10 weeks old but is now known to occur in sheep of all ages, from lambs a few days old to full-mouthed ewes. Generally, death is so sudden that symptoms are not observed. Affected animals seen alive show muscular tremors, and a tendency to lie down and rise at frequent intervals. This is soon followed by a type of tetany in which the animal quickly dies. The *post-mortem* appearances of the fresh carcase show little more than some congestion of the small intestine, often in patches, some excess of pericardial fluid, small epicardial haemorrhages particularly in the coronary groove and splashes of endocardial haemorrhage. The kidneys show some cortical congestion but may be broken down to a pulpy mass in the carcase of an animal dead some hours. A tentative diagnosis on clinical grounds is generally sound but laboratory diagnosis, which we need hardly consider here, should always be arranged to cover the possibility that death was due to some other condition. We understand that observations made at Cambridge have suggested that the presence of sugar in the urine of sheep dead of Type D enterotoxaemia may be diagnostic. Having no opportunity to make observations on that point, we express the hope that others more fortunately placed will cover it in the discussion. In our limited experience it has often

been possible at *post-mortem* examination to differentiate between pulpy kidney disease and Type C enterotoxaemia. The latter is confined to adult sheep and the presence of a large amount of straw-coloured peritoneal exudate is quite characteristic. In addition the excess of pericardial and pleural fluid is pale yellow and even if the sheep has been dead only a few hours some deep red muscle lesions are common. We know of many instances in which the differentiation made on *post-mortem* appearances has been sound, but maintain that tests for toxin and isolation of bacteria are essential. It is fortunate that the country is now reasonably well covered with Veterinary Investigation Centres at which this type of diagnosis is available to the practitioner.

Prevention by Immunisation

We may now proceed to consider methods of prevention by immunisation. We have long held the view that it is only possible to become confident in methods of immunisation if means are at hand by which the disease under study may be reproduced by methods which simulate the natural occurrence. Pulpy kidney disease has been reproduced but only by expedients which are hardly comparable with field happenings. Until pulpy kidney disease can regularly be reproduced by means which bear some relationship to field conditions, one is limited to intelligent guesses at what is required to protect. In these circumstances, one is thrown back on the expedient of trying to determine by field observations what quality of immunity is necessary. This can often be done by providing animals with known levels of immunity and exposing them, together with a reasonable proportion of controls (unimmunised similar animals), to conditions which produce the disease naturally. Unfortunately, pulpy kidney disease is unpredictable in its onset and incidence. We have all experienced its sudden appearance and disappearance for no apparent reason. We know of many attempts designed to determine the level of circulating antitoxin which will protect and in which deaths in significant numbers have never appeared or have ceased, alike among the inoculated and controls. We cannot point to any experimental evidence which defines the inefficient from the efficient level of immunity. We have therefore fallen back—perhaps some will think this a far fall—to a mass of information collected over a long period of years from uncontrolled field observation. This has led us to believe that so long as 0.1 B.Vet.C. units of epsilon antitoxin per ml. of serum is in the circulating blood the animal is protected against pulpy kidney disease. We will not pretend that this level of immunity may not occasionally be swamped by the absorption of exceptionally massive doses of toxin from an intestinal tract in which *Cl. welchii* Type D has found conditions exceptionally favourable to its growth and toxin production. Until there is contrary evidence, we ask that our view of what is necessary be accepted as a working hypothesis.

How, then, may this level of immunity be obtained? We know of four means :—

(*a*) It is not uncommon to find yearling and older sheep which have a so-called natural immunity at or above this level. It seems obvious that at some earlier age they have been "exposed" to the disease by the absorption of epsilon toxin in a non-lethal amount. More usually, the level of immunity resulting from this type of stimulus is of a lower order, but it varies within wide limits from flock to flock, for example in a North of England flock 37.5 per cent., in a West Country flock 89.8 per cent. and in a South Eastern flock 95 per cent. of the ewes carried an immunity below our critical level. Undoubtedly, there are "immune" sheep which have never been vaccinated. This fact has an important bearing on prevention by vaccination, as will be pointed out later.

(*b*) The maternal antitoxin passed by naturally immune or artificially immunised ewes via the colostrum may, and certainly will if the ewe has responded normally to a good vaccine properly used, provide the young lamb with a level of protection which exceeds our critical level. It will remain above it for rather more than four weeks, depending on the level reached within about 48 hours of birth.

(*c*) The injection of pulpy kidney antiserum of B.Vet.C. standard (2 c.c. in lambs and 5 c.c. in sheep over six months old) does provide this protection within twelve hours and for a period of about three weeks.

(*d*) Vaccination with pulpy kidney vaccine of B.Vet.C. quality provides the means of obtaining the immunity we seek. The response to the injection of vaccine must depend on many factors but the essential one is past experience of epsilon toxin or toxoid. If the sheep has a level of natural immunity —even one which our most delicate tests cannot detect—or if it has been previously vaccinated, the response to the injection of a quality antigen is prompt and good. Within ten days it is generally many times our critical level and may continue to exceed it for six months or more. On the other hand, the sheep which has had no previous experience of the antigen gives but a poor response, appearing late (even only at its height forty days later) and possibly never reaching our critical level. Since it is obviously impracticable to determine the status of an unvaccinated flock as to previous experience of the antigen, dependence on a single dose of pulpy kidney vaccine must never be accepted as good practice.

Some Practical Considerations

We may now pass to the application of these means in practice, but before we deal with that point we must consider the age and seasonal incidence of pulpy kidney disease. How very variable it is. In some flocks the disease is known only in forward lambs 6 to 10 weeks old, although the occurrence of the disease in lambs whose life was measured in days is often missed. Outbreaks in lambs folded on special crops or trough fed in late summer and autumn are recognised in the fattening districts but throughout our sheep industry the losses among adult sheep, sometimes occasional deaths over a long period, sometimes a sudden alarming outbreak, take a heavy

toll, perhaps particularly in in-lamb ewes brought on to better grazing in early spring. Possibly the occurrence of major blood mineral deficiencies still confuse the picture among in-lamb ewes, but there are occasions when enterotoxaemia materially reduces the profitability of careful sheep management. It is remarkable that in some flocks the seasonal and age incidence is quite sharply defined, while in others the fear of pulpy kidney disease is constantly in the shepherd's mind. It is, then, difficult to present an immunisation regime applicable in all circumstances. We leave it to the practitioner to determine the line which had best be followed after a study of the history and management of the particular flock, but we feel we must make some suggestions. They are based on our fairly extensive laboratory work and our field experience over many years and will, we hope, lead to a discussion of ways and means which will be generally helpful.

For some years pulpy kidney antiserum was the product of choice, largely because the means of producing good quality serum were known and the veterinary surgeon was rarely consulted except when an outbreak had appeared. The product has been widely used in these circumstances. Certainly the vast majority of reports reaching our hands indicate that the prompt use of serum can cut short an outbreak and hold a good level of protection for several weeks. We know of many instances in which the injection of serum at about monthly intervals appears to have maintained a good immunity over a long period. We cannot, however, but accept that the occasions on which such a procedure is a practical proposition are limited and we only regard serum inoculation as a sound practical step when one is faced with an outbreak or must cover one short period.

To-day, when extensive research has demonstrated the possibility of providing a vaccine of good antigenic quality, we tend to look to vaccination as the main weapon. It has been demonstrated that even the very young can be stimulated to produce an active immunity. How is vaccine to be applied? It cannot give immediate cover. Unless the sheep has already a basic immunity a single injection of vaccine is unlikely to raise the circulating antitoxin to the critical level. The presence of a material level of antibody in the blood, either derived from colostrum or a serum injection, does interfere with response; the development of active immunity is delayed and the response is poor but the animal is prepared so that it immunises well to a second injection.

Faced with an outbreak which is very likely to be of limited duration serum injection is the choice but, where any continuing loss can be anticipated, vaccine should be injected at the same time, from a separate syringe and at another site. A second dose of vaccine must be given but should be delayed until at least four weeks after the simultaneous injections—the advantage lies in delaying until at least six weeks have elapsed. Perhaps this circumstance is most likely to arise among young lambs and we might properly say here that we do not hesitate to recommend serum (lamb dysentery serum injected within 12 hours of birth where the need exists) and vaccine being given to lambs even only a day or two old.

The Maintenance of an Immune Flock

But let us consider the flock in which pulpy kidney disease occurs among young lambs, in fattening lambs and in adult sheep. Since we have often seen the disease in lambs only a few days old, and since we now know that we can vaccinate the ewe to provide a good colostral immunity in the lamb, we would encourage the immunisation of the breeding flock. Quite early in autumn the ewes should be vaccinated, and if losses are anticipated before lambing these ewes should be revaccinated some two weeks before that season of risk. These two doses should provide good cover against the spring loss of adult sheep, but the interval between revaccination and lambing may be too long to provide the best level of colostral antibody. In these circumstances a further revaccination should be practised at about two weeks before lambing is due to commence in the flock. Our expectation is that such vaccination should keep the ewes protected for at least six months and probably until the following spring. If, however, pulpy kidney should occur in the ewe flock at any time thereafter the giving of a further dose of vaccine will rapidly stimulate a very high level of immunity. Provided these ewes are revaccinated shortly before any future lambing, they will regularly pass to their offspring sufficient protection to cover the first six weeks of life. The lambs from immunised ewes may properly be vaccinated within the first few days of life, and revaccinated six weeks later to provide protection for at least six months. Being basically immune they will respond in a very full fashion to any further injection of vaccine. Following this procedure one should be able to build and maintain a flock in which loss from pulpy kidney disease is held to a minimum. Where the opportunity to immunise the ewes before lambing has been missed one may safely set out to have immediate and long-term cover by injecting the lambs with antiserum as a substitute for the maternally transmitted immunity and vaccinating as suggested above.

We have not yet had the opportunity to examine so closely the position in respect of enterotoxaemia due to *Cl. welchii* Type C, but since, to the best of our knowledge, it occurs only in adult sheep the problem is much more simple. A good antigenic vaccine to cover this type of enterotoxaemia has been available for some years and lamb dysentery antiserum gives all the immediate cover necessary. The latter can be used in the face of an outbreak and vaccine applied for long-term protection along the lines suggested in considering the prevention of pulpy kidney disease in ewes by vaccination.

There remains the necessity to note that in some few flocks and areas both types of *Cl. welchii* enterotoxaemia occur. To meet these rather special conditions a combined vaccine giving good cover for both types can properly be substituted for pulpy kidney vaccine in the schemes of immunisation outlined in this paper.

We hope that our determination to limit our remarks to cover the substance of the title on which we were asked to speak is no disappointment and that this paper will serve the rather selfish purpose of

providing a platform from which practitioners, investigation officers and research workers will find it possible to widen our knowledge of a most interesting and, we think, important subject.

Summary

It is suggested that enterotoxaemias in sheep are now more prevalent and are of greater concern in veterinary practice.

While there may be methods of sheep husbandry which reduce the risk of loss from this type of disease, none have as yet been devised which do not interfere with maintenance of the flock in full production.

In these circumstances, immunisation occupies a particularly important place in providing protection. While antiserum of B.Vet.C. standard affords a good immediate but temporary cover, vaccines of the quality now accepted can be applied to give protection for long periods. Schemes of vaccination to meet the various age and seasonal incidences are outlined.

THE OPENER'S SPEECH

Mr. D. Harkness (South Molton) said: I would like first of all to thank the organising committee for asking me to open the discussion on this paper. I would also like to congratulate them on their choice of this subject. Since the Congress is being held in Devon, where there is a large sheep population, the problem of prevention of enterotoxaemia of sheep has to be constantly faced by those of us who practise in the rural areas of the county. Furthermore, I most heartily congratulate the organising committee on their selection of the authors of the paper. Indeed it would be fair to say that any discussion on this subject would be incomplete if the names of Montgomerie and Thomson were not associated with it. As you know Dr. Montgomerie carried out much of the original work on this disease in North Wales and Mr. Thomson's work for the Wellcome Foundation at Langley Court is well known. It is my great privilege to say thank you to these two gentlemen for their excellently clear and informative statement of the problem as it is known to-day.

My own interest in Type D Enterotoxaemia of sheep goes back more than a dozen years (I have no experience of Type C Enterotoxaemia). It was about that time that I was banished for my sins to the wilds of North Devon. My experience is therefore limited to that time and the south-west. The paper suggests that there is an increase in the incidence of the disease. I am very doubtful if over that period there has, in fact, been any marked increase in the incidence of the disease. At the beginning of that period, the great food production drive was under way and many old pastures were being reseeded with leafy strains of grasses quite unsuitable for sheep grazing. I believe there were as many outbreaks of disease then as now. What I would say is that the sheep farmer has been gradually educated to the value of preventing his losses by immunisation methods, and the popularity of this mode of control has gradually increased because of good results obtained. Hence the demand for the necessary biologicals has steadily risen. This fact is an indication of the efficiency of the sera and vaccines rather than a strict measure of the incidence of the disease.

The case for the prevention of enterotoxaemia by immunisation has already been proved in the field and the writers of the Paper have shown in a manner which leaves no room for argument as to how best the various methods of immunisation can be applied to obtain adequate immunity under differing sets of conditions for different classes of sheep stock. I was very interested to see the percentage figures of sheep which carry a natural immunity. I was not surprised that the West Country should show a high rate of natural immunity. This area appears to be the natural home of clostridial infections. Perhaps we in the West can rely on this fact to help us in limiting the amount of vaccination. It is clearly good practise to vaccinate the breeding ewes twice yearly and to use antiserum to control sudden outbreaks. Our ability to produce a solid immunity in young lambs by using the new type of vaccine is a big step forward, although past experience using antiserum has been generally very good. The position to-day is that we can provide a complete biological cover, which should practically eliminate losses from the disease. The question is shall we be allowed to use it? The sheep farmer counts his pennies like anyone else and if he can reduce his losses by alternative and apparently less costly methods such as change of husbandry he will try these first of all. I think this is very likely to happen if the economic value of sheep falls from the present level. You will have noticed that the main Paper states that all the known methods of control—other than by immunisation—interfere with full production and are to that extent bad. This is perhaps so. It all depends on what you mean by full production. But if production is pushed to the point where the health of the flock is in danger, then to my mind at least this is bad husbandry and one should try to have it corrected. In practice I find myself trying to balance between the two methods of control, and I think a great deal can be done to reduce losses by wise husbandry. Very sudden changes in the status of the grazing can be avoided if the flockmaster appreciates the danger, and although our advice often goes unheeded and mostly unrewarded, I feel that we cannot dismiss well-balanced husbandry as a method of control of enterotoxaemia.

Aetiology of the Disease

Since the aetiology of this disease is so wrapped up with husbandry, I must say a word about it. You will notice that Dr. Montgomerie and Mr. Thomson have been admirably restrained on this point, but I think that most people will agree that Type D enterotoxaemia is associated with a heavy intake of high quality food. Whatever the actual mechanism involved in the production in and absorption of toxin from the bowel, the evidence of overfeeding being the exciting cause is too overwhelming to be in doubt. I hold the view, rightly or wrongly, that weather conditions play an important part in the development of the disease. When conditions of humidity and temperature are such that grass is growing "all round the clock," I believe that outbreaks are predictable in lambs with good nursing mothers, especially grazing on the young leafy types of pasture. Flockmasters should be made aware of the danger, chiefly to strong single lambs, in these circumstances. When sheep are fatting on roots in the autumn, it is common to get enterotoxaemic death when there are heavy morning frosts. I believe that these animals anticipate such conditions and overeat themselves before the frost appears to make the herbage less attractive. Since the meteorological office have found the weather unpredictable this year I suppose this is the best argument for flock immunisation.

We cannot, however, hope to prevent disease until we have made a diagnosis and I have put the cart before the horse and left it last. I can add little to the main paper on this score except that I have recognised what appears to be a sub-acute type of disease in lambs. These lambs stand with the head lowered, appear to be toxic and have some fever. They respond to large doses of antiserum. As to diagnosis on *post-mortem* I pay little attention to the state of the kidney and generally base my diagnosis on the patchy congestion of the small intestine and the greatly increased pericardial fluid. I think it is a mistake to retain the name PK; farmers who attempt diagnosis on this feature will often be led astray and with easy access to biologicals could bring them into disrepute. In my own practice other conditions from which differential diagnosis must be made are chiefly Black disease and blackleg and it is relatively easy for the trained to distinguish these. Unfortunately in the field we cannot wait for the result of laboratory examinations of bowel contents, because the owner naturally wishes preventitive measures to be put in hand at once. I am very interested, therefore, to hear that Cambridge workers have found evidence of glycosuria. This would appear to correspond with American findings and if it can be used as a diagnostic test in the field, it will be of great value to the practitioner in confirming the clinical and post-mortem findings without waiting for other tests.

A Paper like this gives us all the opportunity to reflect on the work of those "back-room boys" who produced the sera and vaccines which we as practitioners grab from our shelves to enable us to do our job in the field. Their work very often goes on behind the scenes without any sort of public recognition. I should like to pay tribute to all these laboratory workers, and especially to the two gentlemen who are with us this morning.

THE GENERAL DISCUSSION

Mr. White (Salisbury) said that he wanted to add his quota of thanks to the two gentlemen who produced this Paper. It had helped him considerably in clarifying his ideas as to the advice he should give to the farmer.

With regard to sugar estimation as an aid to diagnosis, this was first recommended to him by Dr. Barron a good many years ago and he had used it in practice since that time. So far it had not let him down and it was of considerable help in those cases of a very early *post-mortem* before the kidneys became pulpy and where there was an absence of pericardial fluid. Confirmation of sugar in the urine was of quite definite value and would, in his opinion, justify the use of serum immediately.

Mr. White was interested, purely on academic grounds, in the suggested time of 12 hours after the administration of serum before there was protection. One would have thought the period would be shorter. It was realised that if beasts were already absorbing toxin when serum was administrated deaths must be expected possibly up to 24 hours after. Another point of great interest was Mr. Harkness's remarks on methods other than those of serum and vaccine as a means of prevention. Cases seemed to occur very often in the early autumn when sheep were put on to folded kale.

Enterotoxaemia had some similarity to hypomagnesaemia. Both occurred on fields that were forced in growth by means of nitrogenous fertilisers and as a result had a high water content. After the kale had been frosted several times and was not so luscious it was found that enterotoxaemias tended to stop. The feeding of a small ration of hay would very often stop cases immediately. That was brought to Mr. White's notice by an agricultural organiser in Wilts, a very able man, who when going round farms gave the advice "You feed them some hay and your deaths will stop." This had to be weighed in the balance against the cost of serum.

In flocks in which enterotoxaemia was occurring scour was a common symptom in the flock. The sheep were quite well but they tended to have scours. What was that indicative of? Was it to do with the quality of the food or with the disease?

As one who slipped up this year in the administration of alum precipitated vaccine, with resultant abscess formations, he would like to hear the authors give a little help with regard to the precautions necessary in the usage of this vaccine. He had not obeyed strictly the directions, having administered it to the shoulder instead of the side of the ribs, but what was perhaps more important was that it was used during a rain storm. The point might be mentioned to practitioners because it was rather unpleasant when there followed a series of very acute abscesses.

Mr. John Bayliss (South Molton) said that he was interested in this disease because he also resided at its natural home. In the same district as Mr. Harkness he found the same sort of low grade pulpy kidney affecting lambs and for which there had been good results with fairly mild doses of serum. Had this anything to do with the actual chemical make-up of the serum for example, its protein content, rather than the specific effects ?

As for the collecting and handling of flocks, that was becoming the great problem. In order to vaccinate them against four or five diseases it was necessary to plot the time of the year for vaccination very carefully. Were there any technical or commercial difficulties attached to the mixing of these vaccines, preferably at the laboratory, so that in the field one did not have the difficulty of juggling with so many different bottles? He would like to have all the vaccines in one bottle, on occasions!

Mr. C. V. Dayus (Agricultural Adviser to the High Commissioner for New Zealand) said that having been acquainted with the work of Bennetts in Western Australia, Oxer in Tasmania and Gill in New Zealand, he would be failing in courtesy if he did not rise to convey thanks to the authors of this Paper which dealt with one of the most important subjects of disease affecting sheep. He was referring to the clostridial diseases because to the entertoxaemias they should add other clostridial infections, particularly Black disease and blackleg in sheep which was becoming an important matter in New Zealand.

The authors had very clearly given their definition of prevention, and had naturally dealt with the immunological side, but he rather felt that they sheltered behind the fact that a high standard of vaccines and antisera treatment were involved and were apt to overlook the real aetiological factors behind enterotoxaemias.

It was mentioned that the investigations carried out so far had not contributed anything really regarding the factors which led to the absorption of toxin, and death. Mr. Dayus felt that the time was ripe for the younger investigators to explore this field once again without detracting one iota from the investigations which had done so much to elucidate this problem in the past. He was sure there were other enterotoxaemias which occurred that were not necessarily bacteriological, in addition to those referred to in the paper, and which were more important than they had hitherto expected to be the case.

References were made to diet and to climatology, and both were highly important. They were factors which should be seriously taken into consideration.

In a dry period when there was a sudden change in rainfall and humidity and a quick growth of grass or lucerne one could almost predict deaths in sheep from enterotoxaemia, not necessarily bacterial enterotoxaemia. There was something in the food factor which gave rise to enterotoxaemia, particularly in the older sheep, and there were certain conditions in the field under which cases occurred which led one to think there was a factor involving food.

Mr. Dayus said he was always under the impression that there was not a very strong immunological response by very young lambs. As far as New Zealand was concerned, the practical approach must be considered. If one had ewes lambing and other ewes still to lamb it would be impossible in practice to vaccinate the very young lambs in any case, but he always understood the immunological response was rather poor in the young. At any rate, there was a lapse before the immunity developed and there was one phase in which there must be immunity or protection at the age of three weeks. The maximum mortality rate was experienced among young lambs between about three and eight weeks of age.

He presumed alum precipitated vaccine was used because of its higher immunising value. It was important to recognise the trouble connected with this when vaccinating sheep likely to go into the freezing works for slaughter for food within a short period of vaccination because there was an objectionable lesion that sometimes occurred. He did not think the weather conditions had anything to do with it. He was under the impression it was due to the deposition of alum in the actual site of vaccination.

Dr. W. R. Kerr, B.SC., D.V.S.M. (Belfast) said that he wanted to offer his congratulations to the authors. The Paper was up to the standard of the Wellcome Foundation in a subject which was peculiarly theirs. In dealing with vaccination the paper said, "On the other hand, the sheep which has had no previous experience of the antigen gives but a poor response, appearing late (even only at its height 40 days later) and possibly never reaching our critical level." He had not been working with sheep but with calves and he did not think that immunologically there was a great difference between the two. Briefly, his finding was that one could not immunise the young calf in its very early days, in our case with abortive and trichomonad antigen. At 30 days it was found that only a poor immunity was produced, and the calf was approaching 50 or 60 days before it would respond actively to an immunological dose. Another point was that if in the first week one gave a large dose of vaccine the calf was paralysed immunologically against that antigen. He had animals which were blocked in the first week and those animals were still blocked to the antigen concerned but not to others.

Mr. J. Barr (Penrith) said that he wished to congratulate the authors of the Paper, and the very able manner in which the discussion was opened was also worthy of praise. He disagreed with the statement that Devon was the natural home of the clostridia as it appeared to thrive exceedingly well in the North. Previous speakers had indicated that sheep in the South were plentiful, in the North they were not scarce. Where there were sheep and clostridia there was usually enterotoxaemia, and in his area in the past there had been seasonal enterotoxaemia affecting both the very young lambs and sheep in the autumn when they were fed on turnips.

During the past few years there had been fairly extensive outbreaks of enterotoxaemia in ewes during their last few weeks of pregnancy. Serum was very useful, but the feeding factor was of great importance at that stage. Sheep owners were not particularly anxious to handle flocks for serum immunisation at that stage of pregnancy. A less succulent food than grass seemed to be beneficial in warding off an attack. Difficulty was experienced in getting pregnant ewes to eat hay at that time of the year, but they would probably eat concentrates.

Much was said about immunisation by vaccination, and the authors maintained that serum gave a very short immunity. Academically that might be so, but Mr. Barr had a very strong feeling that some more lasting and active immunity was obtained following serum immunisation in the actual outbreak. Whether it was due to the animals being exposed to conditions which were optimum for the development of enterotoxaemia whilst they were protected by the serum or not he did not know, but perhaps the authors would give their ideas. There was clinically a sub-acute enterotoxaemia of lambs which responded well to large doses of serum.

He had had the misfortune of witnessing rather severe "blackquarter-like" lesions at the site of inoculation. He was advised that this was not so much the result of faulty technique but was probably due to activation of latent "black quarter" spores, particularly if vaccination was carried out during inclement weather.

Mr. F. V. John, D.V.S.M. (Vict.) (Llandilo) said that it was of great interest to him to be present because one of the greatest headaches one encountered in practice in West Wales was sheep diseases, particularly those involving sudden death. One was rather sorry that the Paper was restricted to the enterotoxaemias because there were many other conditions causing sudden deaths in sheep which required very urgent investigation.

Mention was made of the control of enterotoxaemia by methods of husbandry. The difficulties of control by husbandry were in his opinion great. The economics of farming made it necessary for sheep to alternate between the hill pastures and lowland pastures, and it was hard to see how husbandry could be introduced which would cut down the incidence. Every time the sheep came down from the hills a peak of enterotoxaemia was experienced. Upland hills were being improved and the enterotoxaemias were no longer confined to the valleys but were creeping up the hills.

A peak was reached also in the autumn in his area when farmers were buying their breeding ewes. It was usual to put lambing ewes on to better pastures so as to increase the milk supply and that resulted in enterotoxaemias. Climate and weather factors were very important. A mild winter resulted in outbreaks throughout the year.

He thought they must fall back on vaccines and sera in the control of enterotoxaemias. When the value of sheep increased during the war veterinarians were consulted about sudden deaths and it was found that type D was being incriminated almost entirely. They used type D vaccines and got poorish results. Laboratory people were very helpful and investigated the position and found that type C was far more prevalent than was realised and they were forced to turn to a mixed C and D vaccine, the results then improving greatly.

Mr. John would advise anyone having poor results from type D to try mixing types C and D.

Another factor which interfered with the results of vaccination was a marked increase in Black disease. Black disease appeared to have increased in his area over the last three or four years and it was common to have apparent breakdowns with C and D vaccine and for an outbreak of Black disease to be involved.

Mr. W. H. Parker, B.SC., N.D.A. (Wolverhampton) said that in thanking the openers he wanted to say he was pleased to find the term "pulpy kidney" absent or nearly so, because that was a most unfortunate name that kept cropping up. As a student he was taught that pulpy kidney occurred in lambs and that a disease caused by the same organism occurred without pulped kidneys in older sheep, but one could find pulpy kidneys in any sheep if they were left long enough before being opened up. At the end of the summer the pulp to be found in sheep seemed to relate to the time that had passed since death.

The question of time of diagnosis that was raised by Dr. Montgomerie was interesting, especially when he had suggested, no doubt with his tongue deep in his cheek, that the V.I.O. service might be quicker than that of a certain other laboratory. It did not seem to be so much a question of time as one of obtaining a definite result. Every veterinary surgeon was well acquainted with the report which began, "We failed to find . . ." A negative biological diagnosis for pulpy kidneys did not by any means conclude the issue. The position was not as bad as that of a negative Johne test, but the question was left open. For that reason a second sample should be used before definite conclusions were drawn.

Mr. Parker said that he knew about the time factor only too well because he had made a stick with which to beat his own back in the early days when he was working with Mr. Thomson on this disease. At the Wellcome laboratories he remembered the spectacular technique demonstrated there for diagnosing lamb dysentery when there was a more potent type of toxin. Eleven years ago when he was first working on enterotoxaemia a positive diagnosis was sometimes available 12 hours after receiving a specimen, and ever since the practitioners who had the benefit of that had been saying the most awful things when one dared to take more than two days to make a diagnosis. Sir Thomas Dalling used to say that one required three days before returning a negative result. It would be interesting to hear Dr. Montgomerie's view.

There were certain points which were of great value to those dealing with the more intense methods of husbandry. That was brought home to him by one observant pedigree breeder in Shropshire who announced in relation to an experiment that he would shortly be ringing up to say he had got three dead sheep. Instead of that, an outbreak of foot-and-mouth disease occurred within three miles of his farm, and his sheep were on one side of the road and the turnips were on the other. He brought the turnips across to them because the pastures were by this time bare and the sheep were broken in to the higher levels of feeding slowly. There were no deaths and this man, being a good farmer, had learnt his lesson, although he did not prove of much use in the experiments being carried out on his farm.

Last winter there was much more grass than usual. Grass was growing well into December and, consequently, various other foods were kept until later. The sheep were inordinately fat and there was a lot of trouble over ewes dying in late pregnancy and, of course, after lambing.

Mr. Parker called at one farm in particular where there was definite hypocalcaemia, and there was a definite cessation of losses by the use of calcium in any clinical cases. At the same time there was a number of *post-mortem* specimens to be examined. Some cases were clearly pregnancy toxaemia and others clear-cut cases of enterotoxaemia. This was mentioned because over-fat conditions, which were all tied up with management, seemed to be responsible for all three of these conditions.

It was interesting a few years ago to find enterotoxaemia at all in breeding ewes because at that time they had always considered, on the principle of a check preventing the disease, that pregnancy or milking would be sufficient check. Nowadays this no longer seemed to apply. Mr. Parker came across one veterinary surgeon in practice in Shropshire in the spring who was having a deal of trouble with lambs and was using a lot of pulpy kidney serum—as he called it—though the flocks looked typical cases of worms. He claimed they responded to injections of pulpy kidney serum.

Dr. Montgomerie had already been asked to produce a mixed vaccine. Another commercial organisation was producing a mixture of phenothiazine and trace elements to counteract all forms of "pine." Now there was the claim that pulpy kidney serum cured "pine." Perhaps Dr. Montgomerie would produce one grand mixture for the whole lot!

Mr. S. L. Hignett, B.SC. (LOND.) (Frant) said that it was with some trepidation that he got up to speak, one reason being that he was denied the opening gambit of congratulating the essayists because, just as one did not criticise a chief in public, one did not compliment him under those circumstances. He had only one point to make and no questions to ask. The reason why there were no questions to ask was not that he possessed a profound knowledge of the subject under discussion; rather did he suffer under the disability of a lack of knowledge.

The essayists and other speakers had referred to the importance of environmental conditions and husbandry in the aetiology of the enterotoxaemias. He came forward to support Mr. John of Llandilo. The essayists told them, quite rightly, that the practical approach to this problem was not an approach by way of changing environmental conditions, but rather a direct or indirect approach by way of tackling the infective agent responsible. It was Mr. Hignett's opinion that when there was a syndrome in the aetiology of which environmental factors as well as infective agents played a part then the practical solution in the vast majority of cases consisted of tackling the infective agent. There was nothing original in this assertion. It was made to good purpose three years previously at Eastbourne by Dr. Stableforth. On that occasion, when they discussed Johne's disease, some of them obviously lost sight of the fact that no Johne's bacilli meant no Johne's disease. What was true of that disease was true of the enterotoxaemias, as it was of mastitis, discussed the day before.

It should at any rate be appreciated at the present time that to deal with the mastitis organisms there were chemotherapeutic substances which were denied the clinician 20 years ago. That was said lest through some mischance a wrong impression was derived from the meeting of the previous day. Mr. John Hutchinson of the agricultural press was present at that meeting, and experience had taught them to rely on him not to give the wrong impression.

To return to the main theme, the environmental conditions which contributed to some of these disease problems such as the enterotoxaemias did appear to be inseparable from higher productivity. A reference was made to the leys, and if higher productivity brought in its wake new problems or enhanced the importance of old problems then they must desist from a recommendation which would lead to lower productivity. If higher productivity brought problems with it, it was up to the veterinary profession to solve those problems and, above all, they must not resort to putting back the clock.

Mr. G. F. Kershaw (Newmarket) said that he would like to have clarified the position concerning the immunisation of young lambs. It was said in the paper that if lambs obtained either passive immunity from their dams or in the form of sera then this would to some extent neutralise the use of early inoculation. Would not then the advice of serum combined with vaccine hinder the production of active immunity? It was also mentioned that immunity did not really develop until the second vaccination owing to the fact that the first was neutralised by the antibodies which were passed by the colostrum.

It would appear that there was a considerable vulnerable period up till six weeks of life of the lamb. Surely this would be an extremely dangerous period in lowland districts. How long would immunity be set up when two vaccinations of alum-precipitated toxoid were carried out at a fortnight and six weeks?

Mr. H. M. Wilson (Cupar, Fife) said that he would like to congratulate the writers of the paper and the opener on the work they had presented. There was much background to that work and it was of immense value to the nation as a whole. He most heartily endorsed the words of Mr. Hignett. They all had a most valuable contribution to make to the nation in rendering available as much animal product as possible for consumption. The population throughout the world had risen rapidly, and they must be able to cope with it. In his own area losses due to enterotoxaemias had increased very much within the last few years. Not only did the trouble occur in sheep but it appeared to occur in a fair number of cattle. It was diagnosed as such clinically. For the sheep there were special containers which were put on the train for a most efficient V.I.O. service which reported back very promptly on every occasion. For cattle the position was rather different, but the V.I.O. service was expected to be extended. Sufficient be it to say that at the moment, by control measures for the cattle as for the sheep it was possible to get a grip on the condition.

With regard to sheep losses, there were two types of sheep farms in the area. There were the breeding flocks and the feeding sheep: the latter were bought in the month of September. They were fattened throughout the winter and the last of them sold off in April. The farmers were advised to inoculate these sheep, or to have them inoculated, with serum and/or vaccine, according to history or requirement.

One ran into an occasional case in which immunity apparently was not established and there was a loss of sheep which had been serumed and vaccinated three times and still toxins were recovered.

Where losses were occurring in sheep which had a heavy parasitic infestation Mr. Wilson advised the farmer on how to protect the sheep against enterotoxaemia because when they were on the up and up there were liable to be losses through that condition.

THE REPLY

Mr. Thomson, in replying to the discussion, said that on any Paper that was jointly presented there must be points raised on which both of the authors would like to comment and reply, and no doubt Dr. Montgomerie would, in fact, join in answering some of the questions that had been put. It had pleased both of them to see the very great interest which was shown in the Paper.

Mr. Harkness was to be thanked for the very able way in which he opened the discussion. Mr. Harkness being at the using end of the biological products in which they were interested might quite well have been critical of some of the suggestions made in the Paper. The measure of success he had enjoyed in the use of prophylactic treatment, one could be sure, was in no small way due to his own intelligent approach to this very difficult problem.

It could hardly be claimed that Devon was really the greatest hotbed of type D enterotoxaemia. The organism was completely ubiquitous. Whereas type C was mentioned as a common cause of enterotoxaemia in Wales and in the Romney Marsh area, and type B caused heavy losses in lambs in many areas (strangely enough not in the thickly populated sheep areas in Kent), there could be few areas or indeed farms where type D in one of its forms had not been encountered.

On the question of natural immunity there was great variation from area to area, even flock to flock. The absorption of bacterial toxins in small amounts was a very good thing, but the margin between what was good and what was bad might be quite narrow and the amount which was meat for one sheep might quite well be poison for another. The sub-acute forms of enterotoxaemia mentioned were probably tied up in some way with a circulating antibody-toxin production balance. There came the point at which more toxin was being produced than could be neutralised, and this gave rise to the less acute and the non-fatal types of enterotoxaemia.

Regarding the use of serum in sub-acute cases, Mr. Bayliss was successful with smaller doses of serum because obviously the small amounts of toxin being absorbed would be neutralised by smaller doses of antitoxin.

The protection afforded by antiserum in young sheep, often well beyond the point one would expect from a prophylactic level for antibody, also seemed to be connected in some way with self-immunisation. In this instance the development of antibodies resulting from the intake of small amounts of toxin was made under the protective cover of the injected serum. The animal immunised itself. There was no doubt at all that such animals, having already been

trained in the production of antibodies, were very good subjects to have in any flock one wished to protect by vaccination. They responded more quickly and effectively to the secondary stimulus, which, in these cases, would be the first dose of vaccine. The success or failure following a single dose of vaccine was directly dependent on this naturally immune state.

Reference had been made also to the balance between what might be called husbandry protection and control by the use of prophylactics. With the emphasis on the rapid development and maturation of lamb carcases for the food production drive it seemed unlikely that management alone could be the complete answer to the prevention of enterotoxaemia. There would always be the greedy feeders and they were the ones that succumbed to enterotoxaemia.

The question of diagnosis had been raised, and particularly the delay in receiving reports. The point should be made that the opening of some of the specimens received in the laboratory was often a very nauseating experience, and some delay might be accounted for by the time it took the research worker to recover!

It was pleasing to hear of the successful use of the sugar test. Mr. Thomson did not think it was widely used and personally had no experience of it.

As regards the interval between the injection of serum and when one could expect protection, if the serum was given subcutaneously the peak level might well take between two and three days to reach, but the protective level should be reached by the 12th hour.

Abscess Formation

The problem of abscess formation at the site of injection was a very worrying one indeed. Although the overall incidence of trouble at the site of injection was quite small, for the veterinary surgeon who experienced a breakdown it was a very serious matter. Several of these unfortunate happenings had been investigated by Mr. Thomson and it was surprising that in the ones examined the organism to be incriminated was always *C. pyogenes*. It did seem to be connected with the site, hence the recommendation of a particular site. It was found that the areas of the sheep where there was less wool or which were in contact with the wet ground were the worst sites for injection.

In one particular instance he remembered, some 70 sheep in a flock of 350 had developped very bad abscesses extending right along the abdominal wall and the sheep were a very sorry sight. In this case, and indeed in all the cases he had investigated, the site chosen for injection had been the wool free and soil contaminated area on the side of the sternum. *C. pyogenes* was a common contaminant on the skin at such sites and there was no doubt at all that a few organisms picked up at the first injection could be carried right through a whole series of injections. This could be demonstrated in the laboratory by lightly contaminating the needle of an injection syringe, inserting it into a full bottle of vaccine and removing the contents dose by dose—each dose instead of being injected into an animal could be inoculated into a bottle of culture medium. The contaminating organism would be found growing in the culture medium inoculated with every single dose.

The choice of the site over the ribs seemed a good one for the reason that it was a very clean site. On parting the wool one could inject the vaccine quite cleanly. It was not pretended that sterilisation of the skin was practical in the vaccination of a large flock, but the choice of a clean site was a great help.

As for mixed vaccines, it was all very well to combine several different types but there came the point when the antibody producing mechanism was being asked to deal with too many antigens; there was confusion and interference between one antigen and another and the end result might well be the failure to set up a satisfactory immunity. If the quality of the diferent antigens could be improved still further, the time might come when more and more diseases could be controlled by the use of a combined vaccine.

Mr. Dayus rightly suggested that much more fundamental work should be done and he, too, well realised that it was a very difficult subject to get down to fundamentally. The experimental reproduction of the enterotoxaemias by methods simulating natural field infection had not yet been achieved and until this was done our knowledge of immunity requirements must accrue from field experiments and general field observation.

The question of immunisation of the very young was touched on. Mr. Thomson said that in the past it had been generally held that immunisation of the very young was impossible. More recently it had been demonstrated quite clearly that young animals were, in fact, capable of response to the injection of antigen, and whether they could or could not be immunised was related solely to the quality of the antigen injected and the presence of maternally transmitted antibody. A good quality antigen injected in sufficient quantity to overcome maternal immunity, would stimulate antibody production even in the new born animal. Even where the response was poor in terms of measurable antibody, there was the laying down of a base of immunity so that when a second dose was applied there was a response which was much more rapid, reaching a peak within 7 to 14 days (secondary response) compared with approximately 40 days following a primary stimulus. It was clearly, then, an advantage to start vaccination quite early, but there was an interval before antibody was produced during which some cover must be provided. This could be accomplished by the injection of serum at the time of the first injection of vaccine. It was of real advantage to combine the two.

With regard to the pulpy kidney occurring in young animals of, say, up to six weeks, and this age group was the only one affected on some farms, the soundest method was to vaccinate the ewes. Ewes that were well vaccinated in autumn and spring did transmit a very solid immunity to their lambs. Such lambs would be covered for six to eight weeks.

On enterotoxaemia in cattle, Mr. Thomson said that he was constantly on the look-out for the presence of anaerobic toxins, but so far there was no real proof in this country that any of the welchii types could be incriminated. However, failure to demonstrate welchii toxins in the bowel of cattle, which had died suddenly, might well be attributed to the fact that the examination of specimens could not be carried out at the right time. The work being done at the existing V.I.O. centres was invaluable in this field of investigation, and more such centres would probably mean more specimens being examined under favourable conditions.

Mr. Thomson hoped that his remarks had covered most of the points raised, and he wished to conclude by thanking Mr. Harkness and other speakers, who had taken part in the discussion, for their very great interest in the Paper.

Dr. Montgomerie said he was sure that after such an adequate reply to the excellent discussion there was nothing more to be said. Therefore, he rose to say it! In fact, there was something to be said. He wished to say how pleased he was with the reception of the Paper and the quality of the discussion. Mr. Thomson perhaps had not gone far enough in expressing the appreciation that both of them felt in that respect. Of course, a very good lead in the discussion was given by Mr. Harkness.

Dr. Montgomerie thought some might wonder whether he was educating Mr. Hignett or whether Mr. Hignett was educating him. At any rate, Mr. Hignett made a point with which he agreed. They must keep trying to improve production. High yielding cows were wanted, and they must protect them against the diseases that went with high yielding cows. The same thing applied to sheep. It was up to them to encourage high production in our flocks by taking all the steps which would permit this, without undue risk.

The word "undue" needed emphasising because no one should leave with the idea that vaccination, even as developed to-day, put an end to all risk. There was a place for common sense management in keeping production at the highest level possible coupled with the intelligent application of methods of vaccination to reduce risk. That was the challenge to the profession and the great majority of them were accepting that challenge and doing their job.

Mr. Dayus missed making the point that he himself had made a real contribution to the subject under discussion.

With regard to Dr. Kerr's point, Dr. Montgomerie said he was one of those who for years believed they could not immunise the very young. He would point out that they

had worked with a different type of antibody from the one which Dr. Kerr used in his studies. It might be dangerous to compare findings when using toxoid as the antigen with those based on the production of other types of antibody. Certainly Mr. Thomson had demonstrated that a good quality *Cl. welchii* epsilon toxoid stimulated a response in very young lambs. The response was not good compared with that of mature sheep. It was, however, a satisfactory primary response in the sense that when a second injection was given there were trained cells in the body which quite quickly produced sufficient antibody. It was accepted that in some flocks many sheep carried a low level of natural immunity so that a single injection of vaccine produced the desired response, but this position could not be readily determined. It was, then, always sound when vaccinating for the first time to give two doses.

Dr. Montgomerie said he wanted to conclude by saying on behalf of Mr. Thomson and himself that the meeting, by showing such interest in the Paper, had paid them both a very nice compliment.

The Chairman said that a very excellent session had been experienced on a very important disease. The thanks of the meeting were due to Dr. Montgomerie and Mr. Thomson, and he called upon the meeting to accord them a vote of thanks in the usual way.

The vote was carried by applause and the meeting then concluded.

Current Literature

ABSTRACTS

Parasitology of Deep Litter. HORTON-SMITH, C. (1954). *Agriculture, Lond.* **60.** 564–571.

The four major requirements of deep litter have been postulated as follows :—

(1) That the litter should be deeper than 6 inches.

(2) That the litter should be stirred when it cakes.

(3) and (4) That moisture and heat are necessary for the reactions to take place.

Horton-Smith studied the temperatures developed and amount of ammonia evolved as these factors affect the survival of coccidial oocysts. Oocysts were killed by 15 minutes at 125·6° F. but the surface temperature of deep litter did not exceed 90°. When the litter was heaped, however, the temperature 10 inches inside the heap reached 140° F. in four days.

Sufficient ammonia was generated below the surface to destroy oocysts but these survived on the surface.

It is emphasised that coccidiosis is a potential danger but susceptible chicks placed on deep litter became resistant ; this indicated that immunity may arise without disease.

Coccidiosis outbreaks were met on litter not built up to the proper level. Here the conditions did not develop suitably for the destruction of oocysts nor for their dilution.

J. S. S.

A Method of Diagnosing Trichomoniasis in Bulls. KENDRICK, J. W. (1954). *N. Amer. Vet.* **35.** 22–23.

In his introduction the author refers to Hess's method of douching the sheath and collecting the liquid in a Hopkins tube (tapering centrifuge tube) and examining the sediment later for *T. foetus* ; also to that of Bartlett who prefers to aspirate the material from the sheath with a plastic pipette and to dilute with saline before final examination. Another worker, Fitzgerald, found a greater concentration of organisms in samples taken by pipette than by swab. The author, however, prefers the following technique—the middle of a 40-inch piece of baling wire is wound once round a piece of rolled 4- by 4-inch gauze sponge and the ends brought together to form a handle. The gauze is saturated with sterile saline and inserted into the back of the prepuce after the prepucial opening has been clipped and cleaned. The organisms are gently " scrubbed " off the penis and on withdrawal several drops of fluid are squeezed on to a slide and examined under low power magnification. Any delay in this examination results in a reduction of organisms and lessened motility. The examination should take not less than 15 minutes. The author reports consistent results using this method on seven affected bulls.

N. S. B.

BOOK REVIEW

Man Meets Dog. Konrad Z. Lorenz 1954. London: Methuen. 15s.

The animal world is badly served by books ; there is no middle way between the tear-jerker, the sentimental, anthropomorphic book of the " animal lover," and the coldly detached clinical description of the textbook. Most of us have become veterinary surgeons by virtue of our interest in, and curiosity about, animals. Most of us know, by our " sixth sense," the mood of an animal. Dr. Lorenz has now interpreted for us our observations and deductions. On reading his descriptions of the social customs and methods of " thought " of the domestic animals, all of us will recognise many patterns of behaviour which we have daily witnessed.

For those who have a country practice, the detailed account of the working dog in his natural habitat will be sufficient ; for those in town, there is a chapter on dog-breeding which should be made compulsory reading for those of our clients who are about to breed show animals.

Some of us will quarrel with Lorenz over his imaginary pre-history of the dog, of the strains of wolf and jackal blood and the permutations derived therefrom. And others will disagree with the author's choice of breed, at least for this over-inhabited isle. But our admiration for painstaking observation as well as for humorous description will make this book essential for our sane appreciation of animals.

As a final commendation, may I suggest that this is the ideal Christmas present for the veterinary surgeon, but that it should on no account be given to the person who declares " that she is passionately fond of animals."

News and Comment

NEW PRINCIPAL OF THE ROYAL VETERINARY COLLEGE

As we go to press it is announced that the Council of the Royal Veterinary College, London, have invited Professor R. E. Glover, M.A., B.SC., F.R.C.V.S., to become Principal and Dean of the College, and he has accepted the invitation. As readers will know, Professor Glover at present holds the Chair of Veterinary Pathology in the University of Liverpool.

The newly appointed Principal and Dean was President of the Royal College of Veterinary Surgeons during Coronation year. He became Professor at Liverpool in 1949, having been for the two preceding years the first Director of the Laboratory Animals' Bureau—a Medical Research Council unit. He has been a member of Council, B.V.A. for a number of years, and has served on several of its committees, including the Editorial Committee of which he was chairman in the year 1946-7.

A fuller biographical note will be published in next week's issue.

MR. ARTHUR JOSEPH HANS

The Disciplinary Committee of the Council of the Royal College of Veterinary Surgeons, meeting at 10, Red Lion Square on Thursday, November 25th, directed that the name of Arthur Joseph Hans, whose last known addresses were: 41, Christchurch Road, Ashford, Kent; and The King's Head Hotel, Cuckfield, Sussex, be removed from the Register of Veterinary Surgeons, he having been found guilty of conduct disgraceful in a professional respect at a meeting of the Disciplinary Committee held on May 29th, 1952, in respect of the following charge:—

"That he was, on the 4th day of February, 1952, at the Magistrates' Court, Shoreham, in the County of Sussex, convicted of the following offences:—

1. On September 21st, 1951, being a person authorised to supply drugs, failed to enter in a register particulars with respect to 20 grains of Morphine obtained by you on September 20th, 1951.

2. On October 6th, 1951, in respect of 20 grains of Morphine obtained by you on October 5th, 1951.

3. On November 3rd, 1951, in respect of 20 grains of Morphine obtained by you on November 2nd, 1951.

4. On a date unknown between November 17th and November 27th, 1951, being a person authorised to supply drugs, otherwise than in accordance with the terms and conditions of your authority did supply Morphine to yourself.

and was fined £25 on each of the first three charges and £50 on the fourth charge and ordered to pay five guineas advocate's fee and £2 3s. 2d. witness expenses."

Judgment was deferred for a period of two years subject to an undertaking given by Mr. Hans. Mr. Hans did not appear before the Disciplinary Committee on either September 29th or November 25th when called upon by means of registered letters to his last known addresses and public notices in the *London Gazette* and THE VETERINARY RECORD.

PRESENTATION TO MAJOR J. H. WRIGHT

An interesting ceremony took place last Saturday during the final day's racing when Major G. Cotton, a director of Manchester Racecourse Co., presented a suitably inscribed silver cigarette box to Major J. H. Wright to mark his retirement from the position of veterinary surgeon to the racecourse. Among those present were the Earl of Sefton representing the Stewards, Mr. J. S. J. Lauder, M.R.C.V.S., and Mr. A. L. Bragg, M.R.C.V.S., veterinary surgeons, Mr. W. G. C. Frith, Clerk of the Course and other officials of the Manchester Racecourse Company.

Major Wright is the only surviving official from the days when the racecourse company moved, in 1901-02, from the old racecourse at New Barns to the present headquarters at Castle Irwell. He first became associated with the company in 1895.

"MITES BY THE MILLION"

This film, produced by the Cooper Technical Bureau, was first seen at the Tenth World's Poultry Congress at Edinburgh in August of this year. It is now being shown more widely, and is, for example, being used by the National Agricultural Advisory Service of the Ministry of Agriculture and Fisheries.

The film is in colour and describes some of the methods recently introduced for the control of the various ectoparasites of poultry. These methods, which were described by Brander & Thomas (1954) in their paper to the Edinburgh Congress, include the use of a low pressure aerosol spray containing a piperonyl butoxide/pyrethins preparation and of a dusting powder and a perch paint, both of which contain gamma B.H.C. The need for the thorough cleaning and disinfection of houses in which red mite infestation has occurred is also emphasised.

The film should be very useful for showing to audiences of poultry keepers, while veterinary surgeons interested in poultry work would also find some points of interest.

Reference

BRANDER, G. C., and THOMAS, P. L. Papers presented to 10th World's Poultry Congress (Edinburgh) (1954) C 86.

COMING EVENTS

Dec. 15th.—Meeting of the Section of Comparative Medicine, the Royal Society of Medicine, at 1, Wimpole Street, London, W. 1, 5 p.m.

Dec. 16th.—Ordinary General Meeting of the South Eastern Division, B.V.A., at the Royal Star Hotel, Maidstone, 2.30 p.m.

Dec. 16th.—Annual General Meeting of the Scottish Division, B.V.A., in the University of Glasgow Veterinary School, 83, Buccleuch Street, Glasgow, 2.30 p.m.

Dec. 23rd.—General Meeting of the Southern Counties Division, B.V.A., at the Grand Hotel, Bournemouth, 6 p.m.

Dec. 30th.—Annual Dance of the Ladies' Guild, Dumfries and Galloway Branch of the V.V.B.F., in the Cairndale Hotel, Dumfries.

Jan. 4th.—14th Ordinary General Meeting of the A.V.T. and R.W's. at the University of Liverpool Veterinary Field Station, Leahurst, Windle Hill, Neston, Wirral, Cheshire, 10.30 a.m.

Jan. 12th.—Meeting of the R.A.V.C. Division, B.V.A., at Boots Pure Drug Co. Veterinary Science Division, The Priory, Thurgarton, Notts, 12 noon.

B.V.A. QUARTERLY MEETINGS

The arrangements for January are:—

Wednesday, January 19th.

10.15 a.m. Organising Committee.
2.0 p.m. Home Appointments Committee.
4.0 p.m. Parliamentary & Public Relations Committee.

At 7, Mansfield Street, W.1.

Thursday, January 20th.

10.30 a.m. Veterinary State Medicine Committee.
2.0 p.m. General Purposes & Finance Committee.

At 7, Mansfield Street, W.1.

Friday, January 21st.

10.30 a.m. Council meeting.

At the Connaught Rooms, Gt. Queen Street.

PERSONAL

Births

PFOB.—On December 2nd, 1954, at "Two Trees," Elm Drive, Elmer Sands, Bognor Regis, to Moira (*née* Robertson), wife of Major Lewis S. Pfob, M.R.C.V.S., of the Uganda Veterinary Service, a son, Alan—brother to Lorna Mary and great-grandson to Lady Robertson.

THOMSON.—On November 22nd, 1954, at Craigtoun, St. Andrews, to Jeane (*née* Corteen), wife of Angus Thomson, M.R.C.V.S., of Cupar, Fife, a son.

Engagement

KEYWOOD—JUDGE.—The engagement is announced between Eric K. Keywood, M.R.C.V.S., only son of Major and Mrs. K. P. Keywood, of Croft Cottage, Claygate, Surrey, and Wendy Judge, only daughter of Mr. & Mrs. R. W. Judge, of Glyn Derwen, Claygate, Surrey.

Marriage

PROVERBS—SCOGGINS.—The wedding took place at St. Edmunds Catholic Church, Southampton, on October 30th, of Miss Jean Marie Scoggins, M.R.C.V.S., only daughter of Capt. and Mrs. H. R. Scoggins, of Newtown, and Mr. Ralph Proverbs, M.R.C.V.S., youngest son of Mr. and Mrs. C. A. Proverbs, of Flint Hall, Barbados, B.W. Indies.

The bride was attended by her friend, Miss Marion Windsor, M.R.C.V.S., and Mr. Patrick Scoggins, M.R.C.V.S., her brother, was best man.

R.C.V.S. OBITUARY

STOW.—Roger John (late R.A.V.C.), of Hilldene, Higham Lane, Tonbridge, Kent. Graduated London, July 7th, 1915; died November 20th, 1954.

ADDRESSES OF DISEASE-INFECTED PREMISES

The list given below indicates, first, the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Anthrax:

Denbighs. Vron Issa, Rhiwlas, Llansilin (Dec. 2).

Derbys. Barehurst Farm, Scropton Road, Hatton (Nov. 29).

Somerset. Wembdon Farm, Wembdon, Bridgwater (Nov. 29).

Staffs. Standon School Farm, Standon Bowers (Nov. 29).

Yorks. Gale Farm, Gayle, Hawes (Nov. 29); Low Gate Farm, Sawley, Ripon (Dec. 1).

Fowl Pest:

Devon. Parsonage Farm, Rockenford, Tiverton (Dec. 2).

Dorset. Kimmeridge Farm, Kimmeridge, Wareham (Dec. 1).

Essex. Church Hall Farm, Colne Engaine, Colchester (Nov. 30); 29, Oakwood Hill, Loughton (Dec. 1).

Herts. 2, Staines Green, and St. Mary's Lane, Hertford (Dec. 1).

Lancs. Canal Bank House, North Lonsdale Road, Ulverston (Dec. 1).

Norfolk. The Bungalow, Norwich Road, Mattishall, Dereham (Nov. 29); Rookery Farm, Thuxton, E. Dereham; Mill Farm, Horsford, Norwich (Nov. 30); The Nest, Bawdeswell Road, Reepham, Norwich (Dec. 2).

Oxford. 194, Garsington Road, Cowley (Nov. 29).

Swine Fever:

Ches. Pidgeon House, Handley, Chester (Dec. 2); Top House Farm, and Moore Farm, Shocklach, Malpas (Dec. 3); Caughall Farm, Caughall, Chester (Dec. 6).

Essex. Bigods Farm, Great Dunmow (Dec. 6).

Herts. Vantorts Farm, Sawbridgeworth.

Hunts. Blenheim Road, Ramsey (Nov. 30); Church Farm, Ramsey St. Mary's (Dec. 2).

Lancs. Betts Farm, Catforth, Preston (Dec. 2).

Monmouth. Lower Clifton Court, Goldcliff, Newport (Nov. 30).

Montgomery. Sevenwells, Leighton, Welshpool (Dec. 6).

Salop. Longnor Hall, Longnor, Shrewsbury (Nov. 30).

Staffs. Lane End Farm, Derrington (Nov. 30); Piggeries at rear of 2, Clarkes Lane, Hateley Heath, West Bromwich; 186, St. Paul's Road, Smethwick (Dec. 3).

Suffolk. The Stores, Lawshall, Bury St. Edmunds (Dec. 1); The Butchery, Stonham Aspal, Stowmarket; Silver Farm, Lawshall, Bury St. Edmunds (Dec. 3).

Yorks. Penfield Farm, Drighlington, Bradford (Dec. 6).

CORRESPONDENCE

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

ATTENDANCES AT B.V.A. DIVISIONAL MEETINGS

Sir,—To-day in THE VETERINARY RECORD Mr. Roger Massey has kindly given us some interesting figures which show how members of the B.V.A. support, very poorly, their Divisions. It is unfortunate that only 26 per cent. of members appear to vote but I doubt if we could ever have more than a 70 per cent. poll. There is a huge body of assistants, many of whom do not get the opportunity to attend meetings because:—

(a) They consider themselves not settled in a job and thus do not join a division of the B.V.A.; (b) They are not given the opportunity by their employers to attend meetings; (c) They are not, as yet, interested in veterinary politics.

However, the fact that only 26 per cent. of members elect the B.V.A. Council shows how disunited, as a profession, we are. We should cease trying to convince ourselves that we are united and the reason is given by Mr. Massey when he refers to " the hard grind of competitive practice." The word " competitive " is so true.

How would any of us like to hear one of our best clients tell us that he had been told by an outsider that there was a new " vet." in the town who was very good and would do the work for much less than we charged? Such things do happen.

There is one Division of the B.V.A. which regularly appeals for a scheme of fixed charges for work done. The usual argument against this is that the charges of a pig practice in Lincolnshire can differ a lot from those in a cattle practice in Cheshire. That is very true but surely each county could agree on some rate of charges—charges which will give us a reasonable living and a worthy return for work performed. We will never be united as a body until we, firstly, organise ourselves at home. Organisation in the counties first, clean up our own doorsteps, and let there really be such things as professional ethics. There is room enough for us all, so let us pull more together and less apart. Then we can give a more vigorous support to our Divisions and make an effort to get a more powerful B.V.A., in which members of Council could—at last—make a stand against some of these schemes which are thrust upon us, for example:—

The Swine Fever Vaccination Scheme. We were informed the farmers wanted this—in fact they were determined to have it and they were such a powerful body we must agree or else!

The Animal Nurses Scheme. This is, no doubt, in process of presentation to the Divisions and Council Members will listen to your views then tell you that unless the profession accepts it some other organisation will train these people.

This competitive spirit in practice has now reached the columns of situations vacant in THE RECORD, where employers compete for the services of assistants, offering all kinds of " bribes " such as " use of *new* car in time off," " 5½ day week," or " every Sunday off." What will we offer next?

Mr. Massey refers to the threat of nationalisation and compares us with the medical profession. It is most important to realise—and many of use don't—that general practitioners in human medicine are not nationalised—they are part-time servants of the Government. The word nationalisation brings to my mind the fact that there are many in our profession who long for it purely for their own benefit, such as an improvement in their status and their powers. I don't want it, unless it brought us conditions now enjoyed by the whole-time Veterinary Officers of the Ministry, such as 9 a.m. to 4.30 p.m. each day, week-ends off, at least a month's holiday a year and most important of all—a pension—a thing I endeavour to provide myself with by insurance at premiums which I cannot really afford unless I lower my standard of living. With the conditions mentioned we might then have a chance to realise that there are other things in life apart from ourselves and our practices, which we could enjoy.

Whilst we all criticise members of B.V.A. Council—and may I add that I am as keen as anyone to do so when I feel the need—we must remember we elected them. If we don't like their policies the remedy is in our own hands.

May I thank Mr. Massey for a letter which has stirred me to write as I have.

Yours faithfully,

J. E. JOHNSON.

2, Carlton Street,
Leicester.

November 20th, 1954.

BIOLOGICAL APPROACH TO MEDICAL GEOGRAPHY

Sir,—Mr. Ernest A. Gray in a letter in THE VETERINARY RECORD of August 7th, 1954, complains of the failure of J. R. Audy to acknowledge the prior work of himself on " The Ecology of Infectious Disease." An article by Mr. Gray, thus entitled, seems to have appeared in the *British Veterinary Journal* of November, 1951, and I am sorry to have

missed it because it revives what I tried to say about 30 years ago.

Sometime between 1922 and 1927 a short and inadequate article by me with the clumsy title "Metereotherapy," on the relation of locality and climate to infectious disease, was published in THE VETERINARY RECORD. I am fairly sure that was the title.

At the time I was not familiar with the word "ecology," but a perusal of the article would show what I was getting at. It has taken a long time for veterinary erudition to catch up with this fumbling instinctive effort of the 1920s, but I do not complain.

Rather do I rejoice at this belated discovery by such moderns as Audy and Gray, of a group of facts which already seemed obvious and important to me in those almost prehistoric days.

I am sorry not to be able to tell Mr. Gray exactly what number of THE RECORD contains my primitive article: in this remote spot one does not have access to those early files.

But research will reveal it!

A general recognition of the truths which have lately impressed Messrs. Audy and Gray is much overdue, and my object in writing this letter is to stimulate such recognition rather than to advertise my initiative in the matter.

Fairly lately, for instance, in a departmental veterinary discussion, a Tasmanian colleague (A. F. Ryan, B.V.SC.) and I were affronted and dismayed by the contemptuous rejection by the, then, official veterinary pathologist to admit our claim that the epizootiology of brucellosis was affected by ecological circumstances.

For too many of our people for too long the germ has been all and the environment nothing, and our thanks are due to the like of Audy and Gray for showing up this common fault in our approach to veterinary problems.

Yours faithfully,

J. W. RAINEY,

Westbury,
Tasmania.

Reference

RAINEY, J. W. (1923) *Vet. Rec.* **3**, 611.

Our correspondent's original letter was headed "Materia-Medica." The reference above applies.—EDITOR.

WILLIAM HUNTING

Sir,—I, in common with a goodly company of members of the profession deplore the passing of the Hunting medallion from the front page of THE VETERINARY RECORD, the child of his own creation and its distinguished Editor for so many years.

To many of the younger generation the name of William Hunting means little; nevertheless, he did a great work in raising the status of the profession in many ways, but the greatest of these was the founding of THE VETERINARY RECORD. Why "the powers that be" have seen fit to remove his name and photograph after they have adorned the front page for so many years passes my comprehension.

Hunting, first and foremost, was a brilliant clinician with a keen analytical mind, and a close observer of the smallest data. Nevertheless, he knew his limitations and he was a fervent apostle of the axiom, "the more I study, the more I learn, the less I seem to know; one fact unfolds itself before my eyes just as soon as I have made myself master of another."

Once, I well remember being called to a case near Derby, my diagnosis was cerebral trouble, but after extended treatment no progress was registered and the owner asked me to take the horse for further observation. At a later date I asked Hunting to come and meet me in consultation. I told him I suspected Psammon, and he put the horse to severe tests after which he said: "This is a puzzling case, I don't know, you may be right," and I interjected: "I may be wrong."

The last time I saw Hunting was when he came and spent a week-end with me. I was horrified at his appearance, a shadow of his former self, but the spirit of the man was still there and his brain as active as ever. Seated in my library behind his inevitable cigar he talked on in a reminiscent mood into the small hours.

His paper was his Bible, and he was ever and anon urging practitioners to send along their clinical cases, for as he was wont to say "clinical records were manna to THE RECORD," and many a time he would drop me a line to the effect that "if you are too busy, just send rough data and I will lick the article into shape."

When I saw him into his carriage, I said "bon voyage, hail and farewell," for I sensed we should never meet again. Within three months a valiant knight had won his spurs.

Yours faithfully,

W. SCOTT,

Fryern Hall,
Bridgwater.

December 1st, 1954.

A VOLUME WANTED

Sir,—I am very anxious to get a copy of Frateur's *The Age of the Horse According to the Teeth*, published by Baillière, and with coloured plates, and if my memory is correct, translated by the late Henry Gray. I would be grateful if any colleague who has a copy and could spare it, would write, telling me whether he would be willing to sell.

Yours faithfully,

J. F. D. TUTT,

"Rothiemurchus,"
Winchester.

December 3rd, 1954.